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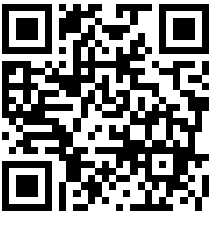

THE

TELEGRAPHIC JOURNAL

and

ELECTRICAL REVIEW

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1878.

IN 1877 a distinct advance was made in telegraphic science by the development of the speaking telephone; but during the past year there have been no less than three notable advances, which reflect honour on the electrical profession, namely, the invention of the microphone, the development of the phonograph, and the introduction of electric lighting. Following upon the speaking telephone of Prof. Bell, the talking phonograph of Mr. Edison was announced as a new and greater marvel at the latter end of 1877; but it was not brought into a practical form until the early part of 1878, when it was exhibited to astonished and admiring audiences in America and England. Although all the magical uses conceived for it in the future by its imaginative inventor may never be realised, we do not doubt that it will ultimately prove serviceable as a vocal signalling appliance as well as a sound repeater, and already it has tended to increase our knowledge of the parts of speech. The phonograph has talked its author into a world-wide fame; and it will ever remain a monument to the strength of his inventive genius.

But public surprise at the phonograph was soon diverted to a third marvel, the microphone. Discovered by Prof. Hughes, in a truly scientific manner, and perfected by him in solitude, its announcement by Mr. W. H. Preece to the Society of Telegraph Engineers took the world by storm. The telephone enables us to speak to distances far beyond the reach of eye or ear, the phonograph renders it possible for us to seal the living speech on brazen tablets, and store it up for any length of time; while it is the peculiar function of the microphone to permit us to hear those minute sounds which are below the range of our ordinary powers of hearing. By these three instruments we have thus received a remarkable extension of the capacities of the human ear, and an accession of dominion over the powers of nature. We have now a command over sound similar in kind to that which we possess over light. For the telephone is for the ear what the telescope is for the eye, the phonograph is for sound what the photograph is for light, and the microphone finds its analogue in the microscope. The carbon microphone used in connection with a battery and an ordinary electro-magnetic receiving telephone, has already proved a practical instrument for sending articulate sounds, with this advantage over a transmitting telephone, that the vocal currents are stronger and not so readily drowned by the induction clamour resulting from messages passing over neighbouring wires. Very soon after the microphone was given unpatented to the world, it was observed by Mr. James Blyth of Edinburgh, and by Professor Hughes himself, that certain forms of the instrument acted as distinct receivers of sounds as well as transmitters, the carbon surfaces in contact being heard to emit audible speech and singing. No practical instrument has resulted from this property as yet, although Prof. Hughes' "hammer and anvil" microphone, mounted on a resonance box, gives very promising effects. The microphone has been utilised in surgery by Sir Henry Thompson in the operation of lithotrity, and by Prof. Rosetti in observing the earth-vibrations which shake Vesuvius previous to irruptions. Professors Houston and Thomson, of Philadelphia, have also applied it as a useful relay for telephone sounds.

The discovery of the microphone was unfortunately marred by one of those controversies as to priority of authorship which sometimes ruffle the serene onflow of science. Mr. Edison, the inventor of the phonograph claimed that the microphone was a plagiarism of his carbon telephone, and preferred a charge of piracy against Prof. Hughes and Mr. W. H. Preece, who, he said, had seen all his experiments while in America in 1876, and had told the microphone secret to Prof. Hughes. A portion of the American press espoused Mr. Edison's side of the affair, and chose to regard Mr. Preece as virtually the thief of the microphone from Mr. Edison, while Prof. Hughes was looked upon as the receiver of the stolen goods. The oddity of a thief who made haste to exhibit his plunder to the public; and of a receiver who freely gave it in turn to the world, did not seem to strike these American writers; but a letter from Sir William Thomson, who was in a certain sense arbiter of the question, charmed away many of the aspersions vented by the American press, aspersions alike unworthy of journalism, and science. Happily the storm has now passed by, and the merits of the case may be calmly studied by those so minded. However it be in America, we may say that in Europe, while Mr. Edison is considered justly entitled to honour as the inventor of the carbon telephone, Prof. Hughes is accepted as the first and true inventor of the microphone, and discoverer of the electric properties of a "bad joint."

More important, in a public and commercial sense, than any of the foregoing inventions, was the appearance of the electric light as a public illuminator in the streets, and at the Universal Exposition, of Paris. The leading mode of lighting there seen

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was the electric candle of M. Paul Jablochkoff, while at some of the railway stations, M. Lontin's system was at work. The wide impulse given to electric lighting by the beautiful display in Paris was soon felt in England, where the Gaiety Theatre was lit by Lontin's system in the latter part of the summer. This introduction of the light into London was followed by the lighting of the *Times* printing and composing rooms, on M. Rapieff's system.

The want of a practical method of sub-dividing the electric light was, however, felt to be a serious stumbling block to its general adoption. On the 4th of October, when public interest in the new illuminator was beginning to rise, Mr. Edison telegraphed to London and Paris that he had solved the problem of sub-dividing the electric light indefinitely; and such was the influence of the inventor's reputation, and the excited state of the financial atmosphere, that a panic in gas shares, from which they have not yet recovered, immediately ensued. The effect on invention in this country was also most marked, and the English Patent Office, for three months afterwards, was charged with patents for subdividing and generating the electric light. Mr. Edison has patented his plan in England, America, and other countries; and is understood to be busy perfecting it and arranging for a public exhibition of it at Menlo Park on an early day. The details are not yet divulged; but it is said that an alloy of platinum-iridium is used as the incandescent light emitter. Grave doubts are reasonably entertained as to the economical success of his system for household purposes, and the gas shares have slowly crept back to a figure more reassuring to holders; but Mr. Edison is reported as being hopeful of his latest invention. Whether he succeed in ousting gas-light from houses and homes remains to be seen; but there can be no doubt that he has made important advances in adapting the electric light for general use. It is certain, at least, that what with the machines of Gramme, Siemens, Brush, de Méritens, and others, and with the candles of Jablochkoff and Wilde, the arcs of Lontin, Rapieff, and Wallace-Farmer, the incandescent carbon lamp of Werdermann, and of Sawyer-Man which we describe in this number, and the incandescent platinum of Edison, the electric light will ere long take the place of gas in streets, factories, warehouses, large halls, galleries, and in shops. There will thus be a permanent gain to the electrical profession as well as to the general public.

Before he engrossed himself with the electric light, Mr. Edison, with his accustomed activity, had invented the micro-tasimeter in which the sensitiveness of the resistance of prepared carbon to pressure is made a means of measuring minute pressures and temperatures. The megaphone, an acoustical rather than an electrical instrument, is the result of his attempt to construct a sensitive ear-trumpet; but although extremely delicate, it is in its present form too clumsy to be serviceable to those afflicted with deafness. The sonorous voltameter, a similar instrument to Bertin's detonating voltameter, invented about the same time, is also a contribution from Mr. Edison during 1878.

New forms of telephones, and telephone calls, new forms of batteries, notably Dr. Byrne's pneumatic battery, in which the current is remarkably increased by pumping air into the liquid, Beaufil's sulphate of mercury conglomerate battery, and Leclanché's conglomerate battery, in which the polariser is made in a lump and affixed to the negative pole, have been constructed. Higgin's improved printing telegraph, Johnson and Phillips' insulator, are also worthy of mention. Nor must we forget the new multiple telegraph instruments of MM. Baudot and Olsen, exhibited at the Paris Exhibition. In pure electrical science, some interesting researches have been made, as, for instance, the investigation of Mr. Spottiswoode on stratified discharges in gases; of Sabine on Selenium; and of Mr. Crookes, on the electric discharge in an exhausted tube, which we give in the present number.

In submarine telegraphy the project for a cable from Aden to the Cape of Good Hope was revived during the past year, with the alternative of a overland line from Khartoum to Pretoria, as advocated by Mr. Scivewright; but no decided steps have been taken to carry out either the one or the other. Arrangements have, however, been made for duplicating the cable communication to Australia, *viâ* the East Indian Islands; and during the year the Eastern Telegraph Company extended their cable system, so as to include the newly acquired island of Cyprus. Duplicate lines were also laid by this company and the Eastern Extension Company. Muirhead's duplex system was also applied to the Madras-Penang section of the latter company, and to the French Atlantic Company. We have reported too that Mr. J. B. Stearns has succeeded in effecting the duplex balance, at Hearts Content, on one of the Anglo-American Atlantic Cables.

1878 has been a fatal year among electrical worthies. While December of 1877 carried off the much respected Ruhmkorff, the succeeding January removed Antoine Cesar Becquerel, the father of electro-chemistry and discoverer of the electro-deposition of metals; and May was marked by the death of Prof. Henry, the venerable Nestor of American science, and discoverer of the self-induction of secondary currents in a closed circuit. In

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April died William Orton, the enterprising President of the Western Union Telegraph Company, a man of whom telegraphists may well exclaim, "How are the mighty fallen." Nor should we forget a countryman of our own, whose humbler achievements have yet made his name a familiar one to English electricians—we mean the late Mr. William Hooper.

AN IMPROVED MANGANESE BATTERY.

By M. G. LECLANCHÉ.

IN a note which I communicated in 1876 to the Academy of Sciences, I mentioned that I had succeeded in combining, by hydraulic pressure, certain depolarising mixtures, among others one formed of carbon powder, peroxyde of manganese and gum lac. The electricity of this solid mass was collected simply by a small prism of carbon, three or four centimetres long.

This was embedded during the compression of the agglomerate; the solid mass so formed constituted the electro-negative pole of the cell, while the electro-positive consisted of a simple pencil of zinc; the exciting liquid being a saturated solution of sal-ammoniac. A hundred thousand cells so constructed have been set up for use, partly for telegraph work, and partly for bells of railway signalling instruments.

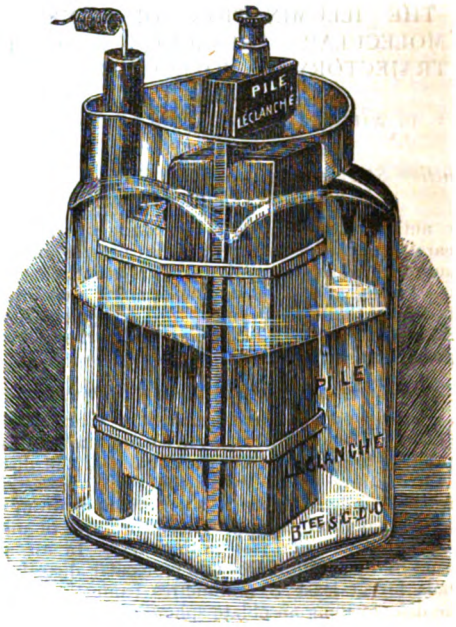
With regard to their use in telegraphy, I have noticed that they work very regularly for nearly eighteen months, uninterruptedly and without attention; but whenever these batteries have been applied to instruments worked by electro-magnets of low resistance, numerous defects have shown themselves: the electro-chemical work done has never attained 50 per cent. of what it ought theoretically to have done.

In these cells, in proportion to the electrical work accomplished, the peroxyde of manganese, which forms about 40 per cent. of the mass, is reduced to the sesquioxyde, a body which is not absolutely a conductor of electricity; the agglomerate thus becomes more and more resisting, besides which considerable quantities of ammonia accumulate in the pores of the agglomerate, with the inevitable result of disaggregating the latter, whence follows a want of adherence between it and the carbon. The resistance of the cells, which was primarily only about equal to 200 metres of 4 mm. telegraph wire, attains after some months of continuous service, a resistance ten or fifteen times as great.

In telegraphy this defect is not of much importance, the electro-magnets of receiving instruments having an average resistance of about one hundred kilometres; the increase of resistance in the battery being small compared with the total resistance of the line and instruments, the current remains sensibly constant. On the other hand, when the electro-magnets have, relatively, a low resistance, as for example, in railway signal instruments, the increase of resistance in the battery causes variations of current so considerable as to render it inefficacious.

I have succeeded in solving this difficulty by rendering absolutely constant the internal resistance of the cell, whatever the amount of electro-chemical work performed by it.

The resistance of the agglomerate is essentially a function of the conductibility of the mass, and of the adherence of the carbon to this mass. To render it entirely independent of these two conditions, it is sufficient to employ the compressed agglomerate in the form of plates united to a plate of horn carbon, having about half a square decimetre of surface. In this case the resistance of the cell depends only upon the conductibility of the



exciting liquid between the carbon and the zinc This conductibility tends rather to augment than to diminish; in effect, in proportion to the work done, chloride of zinc is formed, which is a very good conductor, and the only variable is the depolarising power of the agglomerate.

This depolarising power is always utilisable and effective, for it is more than sufficient when the agglomerate contains only a few hundredths of peroxyde of manganese. I may say that the reduction is effected to the last atom. The maintenance of elements constructed according to this method is most easy, since it is only necessary, when the cell is worn out, to provide the carbon with fresh depolarising plates.

The old batteries constructed with a mixture of manganese and crushed carbon, contained in a porous vase, or with the cylindrical agglomerates, at present used for igniting platinum wires to fire torpedo fuses, are of somewhat large dimensions. In the construction of my new batteries, I have

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been able to diminish their size and weight by one half. By augmenting the number of plates attached to the carbon, the internal resistance may, so to speak, be indefinitely diminished. These cells may remain charged for an indefinite period, the internal action being *nil* when the circuit is not closed. They, therefore, fulfil all the conditions required for firing fuses. The depolarising action is so great, that a mere fragment attached to a polarised carbon plate serves to entirely depolarise it in less than a minute.

For military telegraphy, I have been able to make cells, which although exceedingly small have but a very low resistance.—*L'Eléctricité.*

ON THE ILLUMINATION OF LINES OF MOLECULAR PRESSURE, AND THE TRAJECTORY OF MOLECULES.

By WILLIAM CROOKES, F.R.S., V.P.C.S.

Induction Spark through Rarefied Gases. Dark Space round the Negative Pole.

THE author has examined the dark space which appears round the negative pole of an ordinary vacuum tube when the spark from an induction coil is passed through it. He describes many experiments with different kinds of poles, a varying intensity of spark, and different gases, and arrives at the following propositions.

Illumination of Lines of Molecular Pressure.

a. Setting up an intense molecular vibration in a disc of metal by electrical means causes a molecular disturbance to proceed from the surface of the disc to the surrounding gas. When the gas is dense, the disturbance only extends a short distance from the metal, and, as rarefaction proceeds, the layer of molecular disturbance increases in thickness. In air at a pressure of ·078 millimetres this molecular disturbance extends for at least 8 millimetres from the surface of the disc, forming an oblate spheroid round it.

b. The diameter of this dark space varies with the exhaustion; with the kind of gas in which it is produced; with the temperature of the negative pole; and, in a slight degree, with the intensity of the spark. For the same degree of exhaustion it is greatest in hydrogen and least in carbonic acid, as compared with air.

c The shape and size of this dark space do not vary with the distance separating the poles; or, except very slightly, with alteration of battery power; or with intensity of spark. When the power is great the brilliancy of the rest of the tube overpowers the space, and renders it difficult to observe; but, on careful scrutiny, it is seen to be there unchanged in size. With a very faint spark the space is still present, unaltered in dimensions, although scarcely visible; and if the power is still further diminished, it fades out altogether, without change of shape.

The author describes numerous experiments, devised to ascertain if this visible layer of molecular disturbance is identical with the invisible layer of molecular pressure or stress, the investigation of which has occupied him for some years.

The Electrical Radiometer.

One of these experiments is as follows:—An ordinary radiometer is made, with aluminium discs for vanes, each disc having a film of mica close to one side. Instead of a glass cup, the fly is supported by a hard steel cup, and the needle point on which it works is connected by means of a wire with a platinum terminal sealed into the glass. At the top of the radiometer bulb a second terminal is sealed in. The radiometer can therefore be connected with an induction coil, and the moveable fly be made the negative pole.

Passing over the phenomena observed at low exhaustions, it is found that, when connected with the coil, a halo of a velvety violet light forms on the metallic side of the vanes, the mica side remaining dark throughout these experiments. As the pressure diminishes, a dark space is seen to separate the violet halo from the metal. At a pressure of half a millimetre this dark space extends to the glass, and positive rotation commences.

On continuing the exhaustion, the dark space further widens out and appears to flatten itself against the glass, the rotation now being very rapid.

When aluminium cups are used, instead of discs backed with mica, for the vanes of a radiometer, similar appearances are seen. The velvety violet halo forms over each side of the cup. On increasing the exhaustion the dark space widens out, retaining as much as possible the shape of the cup. The bright margin to the dark space becomes concentrated at the concave side of the cup to a luminous focus, and widens out at the convex side. On further exhaustion, the dark space on the convex side touches the glass, when positive rotation commences, becoming very rapid as the dark space further increases in size, and becomes flattened against the glass.

Convergence of Molecular Rays to a Focus.

The subject next investigated is the convergence of the lines of force to a focus, as observed with the aluminium cup. As this could not be investigated when in rapid rotation, an instrument was made, having the cup-shaped negative pole fixed, instead of moveable. On exhausting, the convergence of the lines of force to a focus at the concave side was well observed. When the dark space is very much larger than the cup, it forms an irregular ellipsoid drawn in towards the focal point. Inside the luminous boundary a focus of dark violet light can be seen converging, and as the rays diverge on the other side of the focus they can be seen spreading beyond the margin of the dark space; the whole appearance is strikingly similar to the rays of the sun reflected from a concave mirror through a foggy atmosphere.

Green Phosphorescent Light of Molecular Impact.

At very high exhaustions the dark space becomes so large that it fills the tube. Careful scrutiny still shows the presence of the dark violet focus, and the part of the glass receiving the rays diverging from this focus shows a sharply defined spot of greenish yellow light. On still further exhaustion, and especially if the cup is made positive, the whole bulb becomes beautifully illuminated with greenish yellow phosphorescent light.

This greenish yellow phosphorescence, characteristic of high exhaustions, is frequently spoken of in the paper. It must be remembered, however, that the particular colour is due to the special kind of soft German glass used. Other kinds of glass phosphoresce of a different colour. The phosphorescence only takes place under the influence of the negative pole. At an exhaustion of four millionths of an atmosphere,* no light other than this is seen in the apparatus. At ·9 M the phosphorescence is about at its maximum. When the exhaustion reaches ·15 M the spark has a

* M signifies the millionth of an atmosphere.

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difficulty in passing, and the green light only appears occasionally in flashes. At ·06 M the vacuum is almost non-conductive, and a spark can only be forced through by increasing the intensity of the coil, and well insulating the tube and wires leading to it. Beyond that exhaustion nothing has been observed.

Focus of Molecular Force.

In an apparatus specially constructed for observing the position of the focus, the author found that the focal point of the green phosphorescent light was at the centre of curvature, showing that the molecules causing it are projected in a direction normal to the surface of the pole. Before reaching the best exhaustion for the green light, another focus of blue-violet light is observed; this varies in position, getting further from the pole as the exhaustion increases. In the apparatus described, at an exhaustion of 19·3 M these two foci are seen simultaneously, the green being at the centre of curvature, whilst the blue focus is nearly twice the distance off.

Nature of the Green Phosphorescent Light.

The author adduces the following characteristics of the green phosphorescent light, distinguishing it from the ordinary light observed in vacuum-tubes at lower exhaustions:—

a The green focus cannot be seen in the space of the tube, but only where the projection causing it strikes the glass.

b The position of the positive pole in the tube makes scarcely any difference to the direction and intensity of the lines of force which produce the green light. The positive pole may be placed in the tube either at the extremity opposite the negative pole, it may be below it, or by its side.

c The spectrum of the green light is a continuous one, most of the red and the higher blue rays being absent; whilst the spectrum of the light observed in the tube at lower exhaustions is characteristic of the residual gas. No difference can be detected by spectrum examination in the green light, whether the gas whose residue it is has been nitrogen, hydrogen, or carbonic acid.

d The green phosphoresence commences at a different exhaustion in different gases.

e Viscosity of a gas is almost as persistent a characteristic of individuality as its spectrum appearance. The author refers to a preliminary note and a diagram* of the variation of viscosity of air, hydrogen, and other gases at exhaustions between 240 M and ·1 M. From these and other unpublished results, the author finds that the viscosity of a gas suffers very little diminution between atmospheric pressure and an exhaustion at which the green phosphorescence can be detected. When, however, the spectral and other characteristics of the gas begin to disappear, the viscosity also commences to decline, and at an exhaustion at which the green phosphorescence is most brilliant, the viscosity has rapidly sunk to an insignificant amount.

f. The green phosphorescence will not turn a corner in the slightest degree, but radiates from the negative pole in straight lines, casting strong and sharply defined shadows of anything which happens to be in its path. On the other hand, the ordinary luminous phenomena of vacuum tubes will pass along any amount of curves and angles.

Projection of Molecular Shadows.

The author next proceeds to examine the phenomena of shadows cast by the green light. The best and sharpest shadows are cast by flat discs and not by narrow pointed poles; no green light whatever is seen in the shadow, however thin or whatever substance be the material casting it.

From these and other experiments, fully described in the paper, the author ventures to advance the theory that the induction spark actually illuminates the lines of molecular pressure caused by the electrical excitement of the negative pole. The thickness of the dark space is the measure of the mean length of the path between successive collisions of the molecules. The extra velocity with which the molecules rebound from the excited negative pole keep back the more slowly moving molecules which are advancing towards the pole. The fight occurs at the boundary of the dark space, where the luminous margin bears witness to the energy of the collisions of the molecules.

When the exhaustion is sufficiently high for the mean length of path between successive collisions to be greater than the distance between the fly and the glass, the swiftly moving rebounding molecules spend their force, in part or in whole, on the sides of the vessel, and the production of light is the consequence of this sudden arrest of velocity. The light actually proceeds from the glass, and is caused by fluorescence or phosphorescence on its surface. No light is caused by a mica or quartz screen, and the more fluorescent the material the better the luminosity. The author considers that the greenish yellow light is caused by the direct impact of the molecules on the surface of the glass. The shadows are not optical, but are molecular shadows, only they are revealed by an ordinary illuminating effect. The sharpness of the shadow when projected from a wide pole proves them to be molecular.

Phosphorescence of Thin Films.

An experiment is next described in which a film of uranium glass, sufficiently thin to show colours of thin plates, is placed in front of a thick plate of the same glass; the whole being enclosed in a tube with terminals, and exhausted to a few millionths of an atmosphere. With this apparatus the following observations are recorded:—

a. The uranium film, being next to the negative pole, casts a strong shadow on the plate.

b. On making contact with the coil, the thin film flashes out suddenly all over its surface with a yellowish phosphorescence, which, however, instantly disappears. The uncovered part of the plate does not become phosphorescent quite suddenly, but the phosphorescence is permanent as long as the coil is kept at work.

c. With an excessively faint spark the film remains more luminous than the plate, but on making the spark more intense, the luminosity of the film sinks and that of the uncovered part of the plate increases.

d. If a single intense spark be suddenly sent through the tube, the film becomes very luminous whilst the plate remains dark.

These experiments are conclusive against the phosphorescence being caused by the radiation of phosphorogenic ultra-violet light from a thin layer of arrested molecules at the surface of the glass, for were this the cause, the film could under no circumstances be superior to the plate.

The momentary phosphorescence of the film, and its rapid fading out, prove more than this. The molecular bombardment is too much for the thin film. It responds to it at first, but immediately gets heated by the impacts, and then ceases to be luminous. The plate, however, being thick, stands the hammering without getting hot enough to lose its power of phosphorescing.

* "Proc. Roy. Soc.," Nov. 16, 1876, vol. xxv., p. 305.

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Mechanical Action of Projected Molecules.

It was noticed that when the coil was first turned on, the thin film was driven back at the moment of becoming phosphorescent, showing that an actual material blow was given by the molecules. Experiments are next described in which this mechanical action is rendered more evident. A small rotating fly, capable of being moved about in any part of an exhausted bulb, is used as an indicator, and by appropriate means the molecular shadow of an aluminium plate is projected along the bulb. When entirely in, or entirely out of the shadow, the indicator scarcely moved, but when immersed so that one-half was exposed to molecular impact the fly rotated with extreme velocity.

Magnetic Deflection of Lines of Molecular Force.

With this apparatus another phenomenon was investigated. It is found that the stream of molecules, whose impact on the glass causes the evolution of light, is very sensitive to magnetic influence, and by bringing one pole of an electro-magnet or even of a small permanent magnet near, the shadow can be twisted to the right or to the left.

The little indicator was placed entirely within the molecular shadow, no movement being produced. An adjacent electro-magnet being now excited, the shadow was twisted half off the indicator, which immediately rotated with great speed.

The Trajectory of Molecules.

The amount of deflection of the stream of molecules forming a shadow is in proportion to the magnetic power employed.

The trajectory of the molecules forming the shadow when under magnetic influence is curved, the action of the magnet is to twist the trajectory of the molecules round in a direction at an angle to their free path, and to a greater extent, as they are nearer the magnet. The direction of twist being that of the electric current passing round the elctro-magnet.

Laws of Magnetic Deflection.

An apparatus was constructed so that the deflection of a spot of light was used instead of that of a shadow; a horseshoe magnet being placed underneath the negative pole to deflect the trajectory. The action of the north pole being to give the line of molecules a spiral twist one way, and that of the south pole being to twist it the other way, the two poles side by side cause the line to move in a straight line up or down along a plane at right angles to the plane of the magnet and a line joining its poles.

The ray of molecules does not obey Ampère's law, as it would were it a perfectly flexible conductor, joining the negative and the positive pole. The molecules are projected from the negative, but the position of the positive pole, whether in front, at the side, or even behind the negative pole, has no influence on their subsequent behaviour, either in causing phosphorescence, producing mechanical effects, or in their magnetic deflection. The magnet only gives their line of path a spiral twist, greater or less according to its power, but diminishing as the molecules get further off.

Numerous experiments were tried in this apparatus with different gases, and with the magnet in and out of position, and the following conclusions are arrived at:—

Working with exhausted air it was found that the spot of green phosphorescence on the screen was visible at an exhaustion of 102·6 M when the mean free path of the molecules, measured by the thickness of the dark space round the negative pole was only 12 millims. Hence, it follows, that a sufficient number of molecules to cause green phosphorescence on the screen are projected the whole distance from the pole to the screen or 102 millims, without being stopped by collisions.

Alteration of Molecular Velocity.

If we suppose the magnet to be permanently in position, and thus to exert a uniform downward pull on the molecules, it is seen that their trajectory is much curved at low exhaustions, and gets flatter as the exhaustion increases. A flatter trajectory corresponds to a higher velocity. This may arise from one of two causes; either the initial impulse given by the negative pole is stronger, or the resisting medium is rarer. The latter is probably the true cause. The molecules which produce a green phosphorescence must be looked upon as in a different state to those which are arrested by frequent collisions. The latter impede the velocity of the free molecules and allow longer time for magnetism to act on them; for, although the deflecting force of magnetism might be expected to increase with the velocity of the molecules, Professor Stokes has pointed out that it would have to increase as the square of the velocity, in order that the deflection should be as great at high as at low velocities.

Comparing the free molecules to cannon balls, the magnetic pull to the earth's gravitation, and the electrical excitation of the negative pole to the explosion of the powder in the gun, the trajectory will be flat when no gravitation acts, and gets curved under the influence of gravitation; it is now also much curved when the ball passes through a dense resisting medium, it is less curved when resisting medium gets rarer; and, as already shown, intensifying the induction spark, equivalent to increasing the charge of powder, gives greater initial velocity, and, therefore, flattens the trajectory. The parallelism is still closer if we compare the evolution of light seen when the shot strikes the target, with the phosphorescence caused in the glass screen by molecular impacts.

Focus of Heat of Molecular Impact.

The author finally describes an apparatus in which he shows that great heat is evolved when the concentrated focus of rays from a nearly hemispherical aluminium cup is deflected sideways by a magnet on to the walls of the glass tube. By using a somewhat larger hemisphere and allowing the negative focus to fall on a strip of platinum foil, the heat rose to the melting point of platinum.

An Ultra-gaseous State of Matter.

The paper concludes with some theoretical speculations on the state in which the matter exists in these highly exhausted vesels. The modern idea of the gaseous state is based upon the supposition that a given space contains millions of millions of molecules in rapid motion in all directions, each having millions of encounters in a second. In such a case, the length of the mean free path of the molecules is excessively small as compared with the dimensions of the vessel, and the properties which constitute the ordinary gaseous state of matter, and which depend upon constant collisons, are observed. But by great rarefaction the free path may be made so long that the hits in a second are negligible in comparison to the misses, and the average molecule is allowed to obey its own motions or laws without interference; and if the mean free path is comparable to the dimensions of the vessel, the properties which constitute gaseity are reduced to a minimum, and the matter becomes exalted to an ultra-gaseous state, in which the new and very decided properties now under investigation come into play.

Rays of Molecular Light.

In speaking of a ray of molecular light, the author

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has been guided more by conciseness of expression than by a wish to advance a novel theory. It is considered, however, that the comparison, under these special circumstances, is strictly correct, and that he is as well entitled to speak of a ray of molecular or emissive light when its presence is only detected by the light evolved when it falls on a suitable screen, as he is to speak of a sunbeam in a darkened room as a ray of vibratory or ordinary light when its presence is only to be seen by interposing an opaque body in its path. In both cases the invisible line of force is spoken of as a ray of light, and if custom has made this correct as applied to the undulatory theory, it cannot be wrong to apply the expression to emissive light. The term emissive light must, however, be restricted to the rays between the negative pole and the luminous screen. The light by which the eye then sees the screen is, of course, undulatory.

The phenomena in these exhausted tubes reveal to physical science a new world—a world where matter exists in a fourth state—where the corpuscular theory of light holds good, and where light does not always move in a straight line, but where we can never enter, and with which we must be content to observe and experiment from the outside.

THE SAWYER-MAN ELECTRIC LAMP.

THE practical usefulness of the electric light for illuminating open spaces and wide areas has been amply demonstrated by the various devices for using the electric arc already widely employed. Hitherto, however, it has not been found economical, or even possible, as we understand it, to construct a lamp or candle, based on the electric arc, that would answer the requirements of ordinary domestic and industrial lighting, where a moderate amount of light, well distributed, easily manageable, and of perfect steadiness and softness, is needed. The electric arc seems, from its very nature, to present insuperable obstacles to the economical production of a large number of small lights in a circuit; in other words, such lights as we require in our dwellings, offices, factories, shops, and the like. And if there were no other means of obtaining light from electricity, the probability of the displacement of gas by it, for the purposes of general illumination, would hardly be worth considering.

The production of light through the incandescence of a pencil of carbon or metal, forming part of an electric circuit and highly heated by its internal resistance to the passage of the electric current, offers an entirely different field for exploration; and though it has long been apparently closed by the failure of early attempts to obtain an electric light by such means, the achieved success of Messrs. Sawyer and Man, not to speak of the reported success of Mr. Edison, clearly indicates that this is the line along which the practical solution of the problem of household illumination by electricity is to come. The lamp, to be described further on, lacks only the practical demonstration of its economy by protracted use on a large scale, to compel acceptance as a successful solution of the problem.

So long ago as 1845, an American inventor, Mr. King, patented in America and England a lamp (said to have been invented by J. W. Starr) involving this principle. His light was produced in a vacuum, to prevent the oxidation of his incandescent carbon or metal, and was extremely promising for its beauty, brilliancy, and steadiness. But it failed to be permanent and economical from various defects and deficiencies, some of which have been removed by the increased power and economy of modern dynamo-electric machines, and by recent advances in the art of subdividing the electric current, but the most of them by the inventions and discoveries covered by Messrs. Sawyer and Man's patents.

The economical division of the current, or more correctly the light produced by a single current—popularly believed to be very difficult if not practically impossible—has been successfully worked out by several American investigators. As long ago as 1875, Mr. Moses G. Farmer, now Electrical Superintendent of the U.S. Naval Torpedo Station at Newport, R.I., subdivided the electrical current, produced by a small machine, into forty-two different branches, putting a light to each branch. Mr. Sawyer's system appears to be able to do the same indefinitely through the maintenance of a uniform resistance throughout the circuit and equal resistances in the several parts of the circuit, as will be shown further on.

The light produced is pure, strong, and yet soft, like sunlight. It is, moreover, steady and cool. It is not influenced by air currents, and it does not vitiate the air by poisonous products of combustion, nor by withdrawing the vitalizing oxygen. The lamp takes up less room than the glass shade of a gas jet, and no more than the chimney of an oil lamp. To a limited extent, also, it is portable, and may be used as a drop light. The general appearance of the lamp is shown in fig. 1. The light is produced by the incandescence of the slender pencil of carbon placed as shown in the engraving. The light-giving apparatus is separated from the lower part of the lamp by three diaphragms, to shut off downward heat radiation. The copper standards lower down are so shaped as to have great radiating surface, so that the conduction of heat downward to the mechanism of the base is wholly prevented. The structure of the base, full size, is shown in fig. 1. No detailed description of this portion will be required, further than to say that the electric current enters from below, follows the line of metallic conduction to the incandescent "burner," thence downward, on the other side, connecting with the return circuit. The light-producing portion is, of course, completely insulated, and also sealed at the base, gas-tight.

A fatal defect in all previous lamps depending on incandescent carbon has arisen from what has been called the "vaporizing" of the carbon. This Mr. Sawyer holds to be an absurdity, since the carbon is not even fused. The wasteage of the carbon in mercurial vacuums, and in atmospheres of compound gas, is due, he holds, to chemical decomposition. Many gases, indifferent to carbon at ordinary temperatures attack it destructively at temperatures obtained in the electric lamp; and the process is continuous, the carbon taken from the burner being redeposited on the glass case, and the gas left free to continue its depredation. Mr. Sawyer claims to have overcome this difficulty by his method of charging the lamps with pure nitrogen, and

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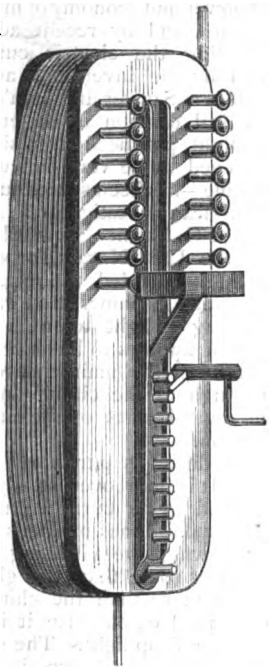
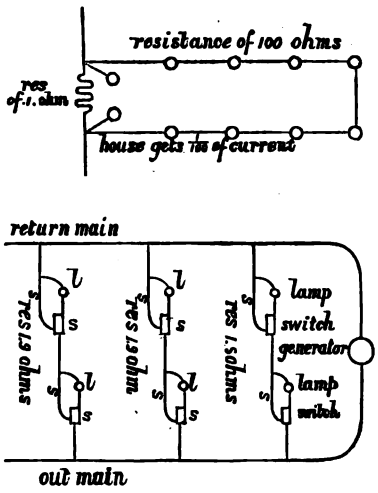


FIG. 2.



FIGS. 4 and 5.

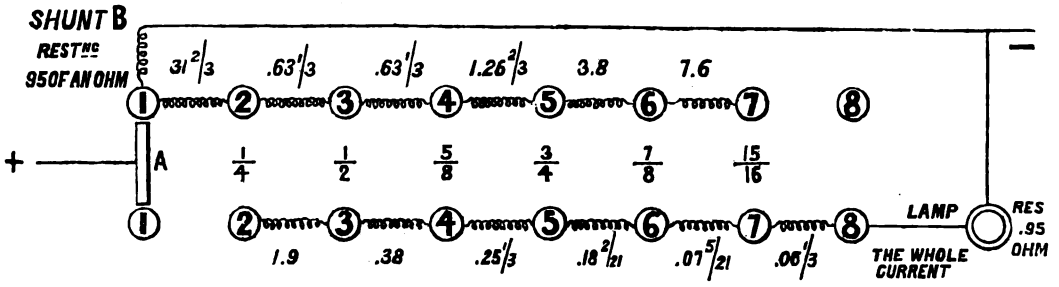


FIG 3.

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by providing for the fixing of any residual oxygen left in the lamp. In this way an unwasting carbon is secured. Another stumbling block on which other workers in this field have come to grief, has been the crumbling or disintegration of the carbon burner, due to sudden heating when the lamp is lighted. This is avoided in the Sawyer-Man lamp by an ingeniously devised switch, shown in fig. 2. By this means it is impossible to turn the current on or off suddenly, to the disruption of the carbon. This, however, is not the only nor the chief advantage of the switch. It is, indeed, the key to the entire problem, the indispensable condition, Mr. Sawyer holds, of practical electrical distribution.

It is well known that an electric current will exactly and readily divide among circuits of equal resistance. Accordingly, if the resistance of a sub-circuit be maintained constant, no matter what may be going on in it, whether a lamp is not lighted at all, or lighted in a mere taper, or to any intermediate stage up to full brilliancy, it is obvious that no other lamp or lamps in that circuit will be affected. The operation of the switch, in securing such uniform resistance, is shown in the diagram, fig. 3.

The lamp has, let us say, a resistance of 0·95 of an ohm. Therefore if one lamp is out there should be a resistance of 0·95 of an ohm in its stead. This is the shunt resistance, B. The currents enters at the "+" point, and leaves at the "—" point. The contact piece, A, bearing upon the two studs, 1, 1, all the current passes out by way of B. When A is moved to the studs, 2, 2, the current divides, $\frac{1}{4}$ going through the lamp, the other $\frac{3}{4}$ by way of B, and the resistance of the combined circuit is $0{\cdot}31\frac{2}{3}+0{\cdot}95=1{\cdot}26\frac{2}{3}$ in the shunt; and $1{\cdot}9+0{\cdot}38+25\frac{1}{3}+18\frac{2}{21}+0{\cdot}07\frac{5}{12}+0{\cdot}06\frac{1}{3}+$(the lamp) $0{\cdot}95=3{\cdot}8$. The resistance of the circuit is, therefore, $\frac{1{\cdot}26\ 2\text{-}3\times 3{\cdot}8}{1{\cdot}26\ 2\text{-}3+3{\cdot}8}=0{\cdot}95$ of an ohm, and so on. In short, the resistance of the circuit is constant at 0·95, no matter what may be the change in the proportion of the current given the lamp, as may be seen by making the required calculation for each pair of studs. The varying resistances required to give the best effect have been worked out by practical trial. The effect of $\frac{1}{4}$ the current through the lamp is to make the carbon a dull red. On studs 3, 3, one-half the current passes through, and the carbon becomes a bright red. On studs 4, 4, the lamp gets $\frac{5}{8}$ of the current, and becomes white hot. On 5, 5, the lamp gets $\frac{3}{4}$ of the current, and begins to assume the intense limpid incandescence of the sun; and the light increases rapidly with subsequent changes until the whole current goes through the lamp.

Thus it is seen that the greater part of the illumination is the product of a small part of the current. When the light is well on, a very slight increase in the current increases the light enormously. It is here that the great loss occasioned by dividing a fixed current among several lamps finds its explanation. A current that suffices in one lamp to produce a light, say of 100 candles, will, if divided between two lamps, give in each perhaps no more than 10 candles, or even 5, making a loss of 90 candles in the sum total. But if the current be doubled, each lamp will give a light of 100 candles, and the sum total will be 200 candles

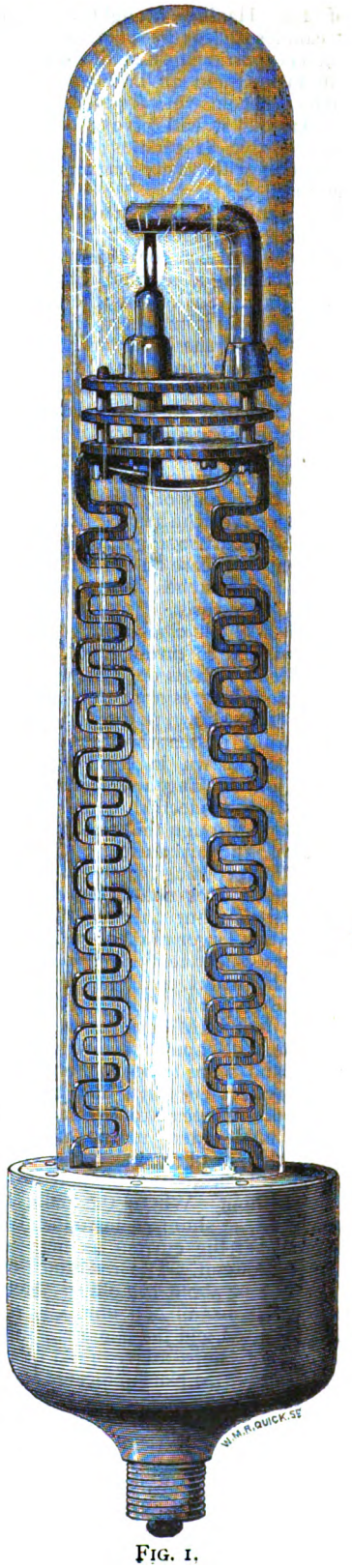

FIG. 1.

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instead of 10. Having brought a candle or a system of candles up to the point of feeble incandescence, a (proportionally) small addition to the current will make them all brilliant. If at 6,000° Fah. a given carbon will produce a light of 3 candles, at 12,000° it will give 9 candles, and at 24,000° it will give 81 candles; the illuminating power increasing with vastly greater rapidity than the temperature.

The wires supplying the current may be run through existing gas pipes, each lamp being provided with a switch placed conveniently in the wall; and by simply turning a key the light is turned up or down, off or on. So long as the house is connected with the main it makes no difference to the producer whether all the lights are on or off, since the resistance of the entire (house) circuit must be overcome; though it will to the consumer, since a meter records the time that each lamp is on, and the charge is rated accordingly. If the Dynamo-Electric Light Company can supply the illuminating force so cheaply that the constant and brilliant illumination of all the rooms of a house can be secured at no greater cost than the partial and intermittent illumination now had from gas, it is obvious that the electric light will score an important point. The cost of lamps and switches, it is claimed, will not exceed that of gas fixtures.

The meter is a simple clock arrangement, with an attachment designed to throw the dial hands into connection when a light is on. From each switch a pair of conducting wires are run to opposite studs on the wooden disc shown at the top of the figure. When no current passes through the lamp the revolving spring shown in front of the studded disc turns without making any record. When the current is on, one electric connection at each revolving is made through the pins assigned to the particular lamp, the armature of the magnet is moved, and the recording wheel is advanced one notch. This meter does not measure the quantity of electricity passing, but only the time a lamp is on. If two or any larger number of lamps are on, an equal number of connections are made at each revolution of the wheel, and the record wheel is advanced to correspond. This registration is, of course, a mere matter of business detail. In view of the well-founded popular dislike to gas meters, however, it would seem to be desirable to dispense with such devices entirely; and the nature of electric distribution appears to favour other and less objectionable modes and means of determining the financial relations of producers and consumers.

Figs. 4 and 5 indicate the method proposed for general distribution. Where the main is tapped for a sub-circuit, a shunt is introduced so as to throw so much of the current as may be needed into the derived circuit. The resistance of say 100 added lamps will be about 100 ohms. By giving to the shunt a resistance of one ohm, $\frac{1}{100}$ of the current will be diverted, and the lamps supplied. When a large number of lamps are required in a circuit, a combination of the two plans indicated is employed.

The diversion of any portion of the electric supply into an added circuit, whether one house or a group of houses, necessarily increases the aggregate resistance of the electric district, and calls for more work from the generator. To meet such contingencies automatically, Messrs. Sawyer and Man have invented and patented a regulator, which responds instantly to any increase or diminution in the demand, thereby securing an absolutely uniform volume of current.

This regulator so controls the steam or other power actuating the generator of electricity, that the amount of power supplied is increased or diminished in exact proportion to the demand, either by changing the volume of steam produced, or by coupling on or detaching different generators or parts of a single generator in circuit.

With regard to the cost of this mode of electric lighting no positive figures can be given. It is claimed to be entirely demonstrated that one horse power will give by the Sawyer-Man system of incandescence a light of 30 five foot gas burners an hour. Where large powers are employed the cost of steam power, every item included, is commonly rated at one cent per horse power per hour. The cost of 150 feet of gas at New York rates is 41 cents, which would make the gas over forty-fold dearer than the Sawyer-Man light. Mr. Sawyer does not stand on this estimate, however, holding that even if the electric light should prove in practice on a large scale to be ten times as costly as calculation indicates, it will yet easily compete with gas, the light furnished being so much better and purer.

It is promised that facilities will soon be offered for the photometric test of a large number of lights, in a circuit, with dynamometric tests of the power employed in generating the electric supply. This, as already noted, is all that the system lacks to prove itself an accomplished economical fact.—*Scientific American.*

[For additional facts as to the cost of the Sawyer-Man light, see our article on "Electric Lighting" in the TELEGRAPHIC JOURNAL for December 1.]

JABLOCHKOFF'S ELECTRIC CANDLE.

WE have on many occasions alluded to the Jablochkoff electric candle, and an illustrated account of it will be found in THE TELEGRAPHIC JOURNAL for the year 1876; but its recent appearance in London on an extensive working scale at the Embankment and the Holborn Viaduct, calls for a description of its very latest developments.

The candle itself consists, as is well known, of two cylindrical sticks of compressed carbon, separated by a strip of insulating material, formerly kaolin, now plaster of Paris, as shown in elevation and cross-section in figs. 1 and 2. These pencils of carbon are each 225 millimetres (8·8 inches) in length, and 4 millimetres (0·157 inches) in diameter, placed 3 millimetres (0·118 inches) apart. Each candle is provided with a conducting tip, composed of powdered plumbago and gum, which is held in its place by a ligature of asbestos. The object of this priming is to start the light when the current is put on and maintain it until the fusion of the plaster of Paris commences, when the latter acts as a partial conductor itself. The lower ends of the carbon stand in sockets of brass, as shown in figs. 2 and 3. One of these sockets or jaws is fixed, and the other (that to the right of fig. 3) is moveable. The left or fixed candle is mounted on a metal base-plate to which the positive pole of the generator is connected by a binding screw. The right or moveable jaw is connected by a metal link to the terminal to which the negative pole

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is brought. The moveable jaw is pressed firmly against the candle by means of a curved spring. By this simple arrangement the burnt-out candles may be quickly withdrawn from their sockets and fresh ones installed.

As each candle burns for only 1½ hours, it is necessary to have four candles in each lamp, in order that a continuous light may be obtained for a proper time each night, and that each fresh candle should be automatically lighted in turn when its predecessor has burned down. The four candles are mounted on a circular base of white oynx-stone, which serves to support and insulate them from each other. They are set in the form of a cross, as shewn in fig. 4, and enclosed in an ornamental globe of white opal glass, 16 inches in diameter, and from ¼ to ⅛ inch thick in the material.

The Gramme dynamo-electric machine has always been used in connection with the Jablochkoff candle. Formerly the continuous current Gramme was employed and then the positive carbons required to be twice thicker than the negative, in order that they might consume at the same rate; but now the alternating current Gramme, described in our last issue, is adopted, and the carbons are of equal thickness. Four distinct currents are drawn from each machine, and each of these currents is made to feed four separate candles in series at a time. Four separate lamps are therefore connected in circuit at once for each current; only one candle of each lamp being lit. In the bottom of each lamp, is placed a switch, accessible by a small trap, for turning on the current to each of the four candles in succession. In the ordinary form, operated by hand, a lever connected to the negative pole of the machine is put into contact with one of four studs connected to the

FIG. 1.

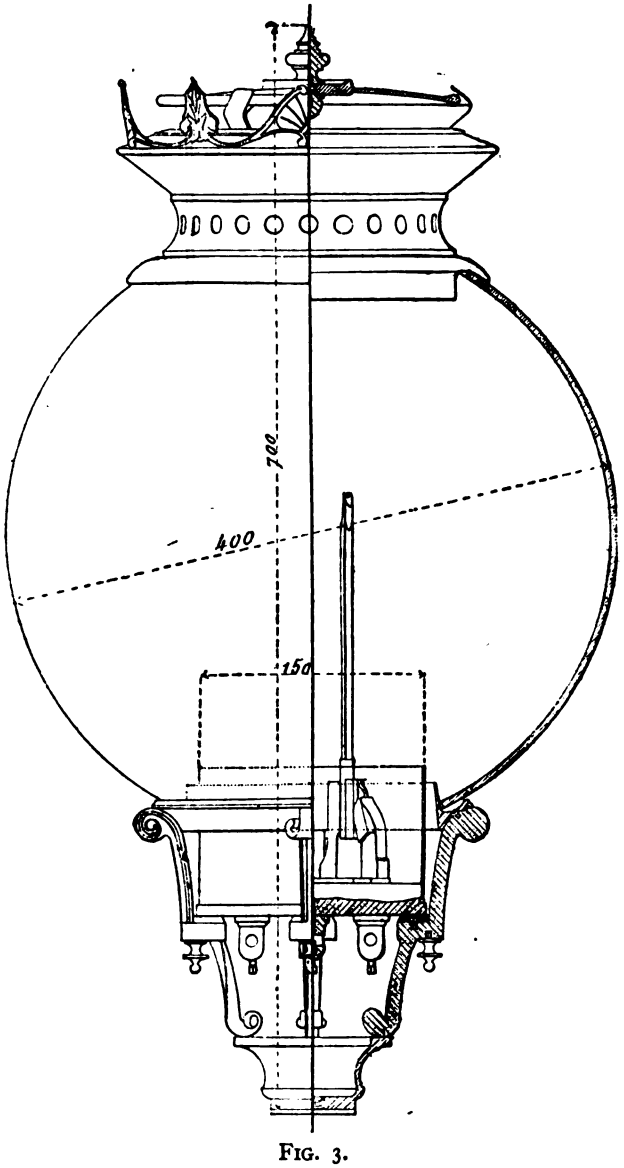

FIG. 3.

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outer or moveable jaws of the candle, while the inner or fixed jaws are connected to the central terminal to which is brought the return wire going to the positive pole of the machine. The switch levers of the four lamps are connected in series, so also are the central terminals. With this switch it is necessary for a man to go round to each lamp and switch on to the next candle; but M. Jablochkoff has obviated this necessity by means of a simple automatic switch, in which the burning of a candle to a certain fixed point frees a platinum detent and releases a spring lever, which makes a contact and instantly diverts the current from the exhausted candle to the next one All four circuits from a machine are connected in this way, and there are, therefore, 16 lamps illuminated at once by the same machine. The conductors are of wire strands of No. 18 B. W. G. tinned copper wire, having a resistance of 1 ohm per 1,400 feet, and insulated with india-rubber. The dimensions in the figures are in millimetres.

Messrs. Wells & Company, Shoreditch, are the agents in London for Jablochkoff's system in London, as the *Societé Generalé de l'Eléctricité* are in Paris. In our article on "Electric Lighting," in THE TELEGRAPHIC JOURNAL for December 1st, we gave the prices quoted by Messrs. Wells & Co. for the supply of this mode of lighting in London; but we may repeat here that probably the whole cost of providing a four-light apparatus including engines, brackets, and the services of a skilled engineer for a short time, to give instructions in its use, would amount to about £400. The cost of the candles is 8d. each, or 5½d per hour. The light from each is estimated as equivalent to 1,000 standard sperm candles when naked, but the opal globes reduce this by 50 or 60 per cent. In calculating the cost of the light as compared with gas, an allowance for interest on capital, and about 10 per cent. for depreciation must be made; but it is obvious that a similar allowance for depreciation should be made in respect to gas fittings.

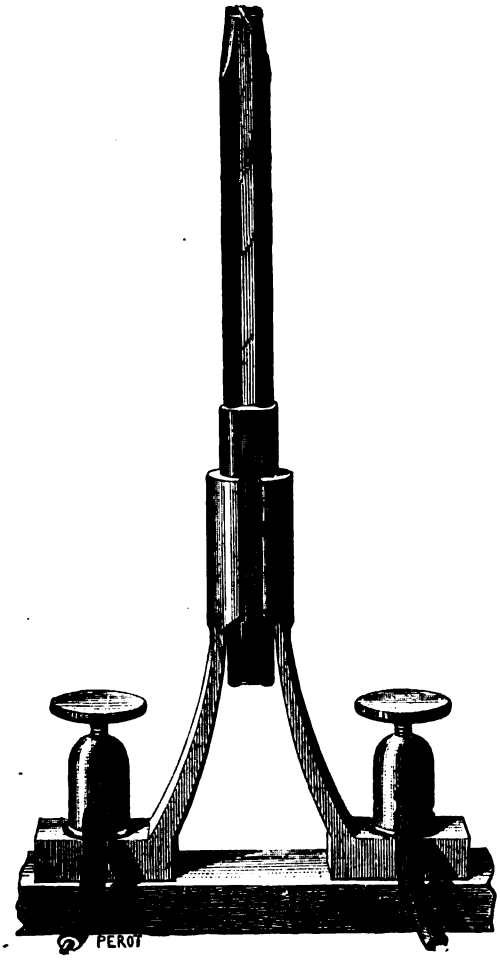

FIG. 2.

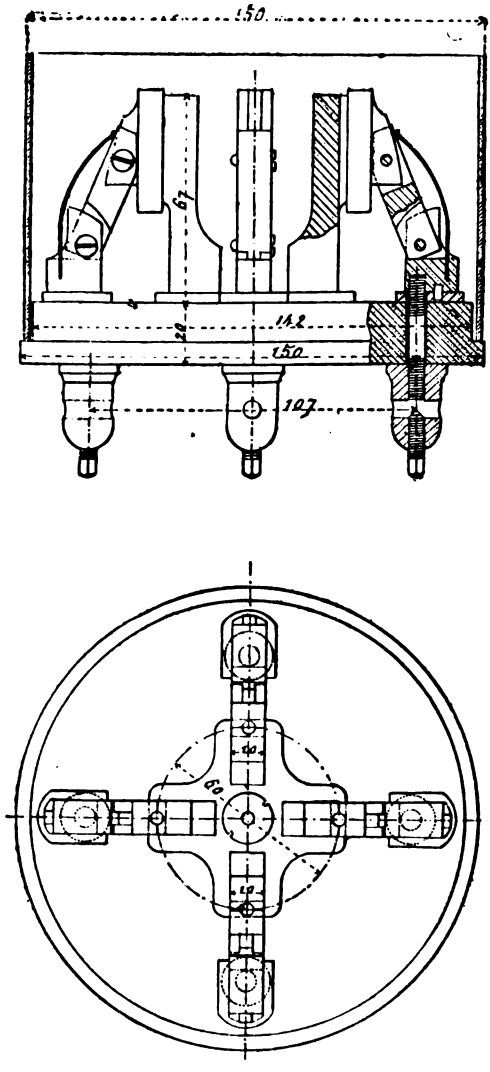

FIG. 4.

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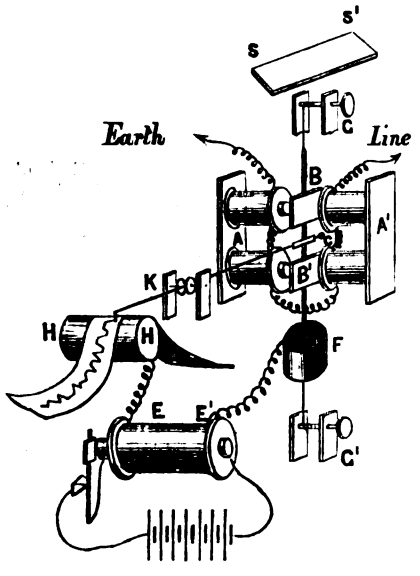
AILHAUD'S RECORDER FOR SUBMARINE CABLES.

THE currents employed on submarine lines being very weak, the electro-magnetic force of the receiver is not sufficient to overcome the inertia of the parts usually employed for recording, and more especially the friction of the paper slip against the inker.

We know how Sir William Thomson has obviated this difficulty in the construction of his Siphon Recorder. M. Ailhaud has just devised a small instrument which fulfils the same purpose.



Two electro-magnets A and A' are arranged as shown in the figure; two small magnetic armatures B, B', face the soft iron cores. These are carried by an aluminium wire, terminating below in an iron point, which dips into an iron mercury-cup F. To the centre of this wire, which is kept vertical by cocoon fibres wound upon adjusting screws G, G', is fixed a long slender indicator of aluminium, C. The received current thus deflects the indicator according to the direction in which it passes through the coils.

The recording is effected by the action of an induction spark upon a chemically prepared slip of paper which is carried by a metallic cylinder H, H, below the marking point.

The induction coil furnished with a contact maker, is actuated by a battery of large-surface plates, its ends E, E', being connected, one with the mercury cup, the other with the cylinder H, H. Thus, when the vibrating contact-maker is in action, a sparking is produced between the point and the paper slip; and inasmuch as there is no friction, the movements of the indicator are perfectly free. Two stops, K, which limit the extent of these movements, and a directing magnet S, S', complete the arrangement.

This receiver works very well with a local circuit comprising a Callaud element and ten thousand ohms resistance.

Upon the Marseilles-Algiers cable it is worked with five cells. The chemical paper is impregnated with a solution of potassium iodide and starch.—*Annales Télégraphiques.*

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.

JABLOCHKOFF'S ENGLISH PATENTS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Seeing that no one in the recent issues of your valuable journal has offered an opinion respecting the assumed money value of the Jablochkoff electric candle patent, mentioned in a previous number, I have ventured to submit the following remarks thereon for the consideration of your readers. The provisional specification was taken out in the name of Mr. R Applegarth, in 1876, and is said to be a communication from "Paul Jablochkoff, of 3, Boulevard Voltaire, Paris." This specification has become "void," as you have stated, "by reason of the patentee having neglected to file a specification in pursuance of the conditions of the letters patent." The question now is, did this lapsed specification claim all the details of the said candle as we now understand it? I think it did; but let the specification speak for itself.

Everyone knows that great stress has been laid on the fact that the Jablochkoff system got rid of the automatous element common to other electric lamps, therefore he will not be surprised to find the specification leading off as follows: "This invention consists of the entire removal of all the mechanism generally used inside electric lamps. Instead of causing the carbon points to approach each other automatically by machinery in proportion as they are consumed, I place them side by side," . . . . "but I place an isolating substance between them, which consumes at the same time as the carbon points; for instance, porcelain, brick, magnesia, or any other isolating substance."

"The carbons used by me may be,—

"1. The ordinary carbon points used for the purpose of electric light.

"2. Hollow carbons of different sizes to admit of one being placed inside the other.

"3. Carbons made of compressed coal, which are well suited to the tube arrangement before mentioned.

"The two carbons thus prepared, are fixed in a stand, which may be described as a special candle-stick, and a current of electricity by means of a battery, or any other source, is passed through them. To light the lamp, I join the tips of the carbons by a small slip of carbon, which, on the electric current passing through, produces light. To prevent one of the carbons consuming more rapidly than the other, I use carbons of different thicknesses to ensure equal consumption of both. I can either place between the two carbon points a piece of the isolating substance or I can place one or both of the carbon points in an isolating tube or tubes."

He also claims to utilize a part of the electric current to put in motion or stop clock work for the purpose of raising or lowering the carbon points, if it be required to keep the light at any particular spot, "for instance, the centre of a reflector."

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Also "the right to produce a coloured light by mixing colouring matter with the isolating substance which separates the carbons." After this I think that no one who has seen the candle and its application will for a moment doubt that whatever value it may be as one of the "new lights," it cannot be of much money value as a patent right after the lapse of so clear a description with drawings. If the patent taken out in his own name in 1877 was intended to redeem the loss, I am of opinion that it will not do so, for if this specification be read in connection with Applegarth's, it will be seen to have reference to the means for holding or setting up the candles than to any improvement or modification, of any value, as regards the construction of the article in question. For instance, he suggests a powder as an insulator instead of a solid substance, which is made clear by saying that "A powder which I find serviceable consists of one part of lime, four parts of sand, and two parts of talc." He then proceeds to say that the candle is made by placing the two carbon rods parallel to each other in a case or cartridge made of asbestos, card, or paper, and the space within surrounding the rods filled in with powder similar to the above-mentioned. Finally, were are told that the construction of the candle may be varied, that is, instead of the carbons being square in section they may be round, and instead of being contained in a cartridge, "merely separated by a partition of kaolin, or other similar insulating material." Here, you see, we are brought back to the first idea of placing "an isolating substance between them," (the carbons), "which consumes at the same time as the carbon points, for instance, porcelain, &c."

After the experiments of Mr. Henry Wilde in connection with the Jablochkoff candle, it will not be out of place to refer to Mr. Werdermann's patent of 1874 as showing that he was the first to arrange the carbons side by side for the production of the voltaic arc, and that too without any isolating material between them, for the purpose of producing light and heat at their points. He says, "The carbon points of the electric light are fixed in a suitable handle or frame provided with pinions and racks to regulate their distance." He then explains how he converts the arrangement during the passage of the current from one carbon to the other into a powerful blow-pipe. There is no mention here of any insulator, notwithstanding the carbons are near enough to allow the voltaic arc to form, and that too only at their points. The fact that carbons mounted as proposed by Werdermann, will burn from their tops downwards until consumed, has been fully confirmed by Mr. Wilde. In fact, his experiments go to prove that the insulator is more harm than good, for we read that "the light from the naked carbons was also more regular than that from the insulated ones." In fine, Mr. Wilde's experiments go to prove that the insulating material is mere damage, and has nothing to do with the conduction of the current when fused, nor the improvement of the light. In conclusion, allow me to add that since our eyes have been opened by Mr. Wilde's experiments, it is easy to see that if the current would pass from one carbon to the other, if not debarred, there need be no carbon slip connecting their tips for the purpose of lighting the candle, as the tips are always clear of the insulating partition.

W. MANN.

THE SOURCE OF SOUND IN THE TELEPHONE.

SIR,—I have read with great pleasure, in the last three numbers of your journal, the articles of the learned Prof. D. E. Hughes upon the origin of sound in the telephone. The experiments made and described by Mr. Hughes complete and confirm those which I have executed to prove that in *the Bell telephone the source* of useful sounds lies in the movement of the diaphragm.

I am the happier to find myself at last in accord with Mr. Hughes, because that accord is the result of experiments conscientiously made and loyally interpreted by both.

Receive, sir, the assurances of my most distinguished consideration.

Echaerbeck, Brussels. NAVEZ.

POSTAL TELEGRAPH SERVICE.

SIR,—Can any of your numerous readers give me a reason for the alteration recently made in our official designation? Originally we were styled "Telegraph Clerks." We are now reduced or promoted—I know not which—to "Telegraphists." I have heard murmurs that the alteration is intended to deprive us of some of the benefits secured by the Playfair commission. While disbelieving this, I should still be glad to hear the explanation for the change.

TELEGRAPH CLERK.

Notes.

THE ELECTRIC LIGHT.—The Thames Embankment, from Waterloo Bridge to Westminster, has been splendidly lit by twenty of Jablochkoff's lamps: while the Holborn Viaduct, from Newgate Street to Holborn, has been lit by sixteen. The illumination of the river-side suggests the probability of the river below London Bridge being lit right across at some future time, so as to allow of nocturnal navigation. Messrs. Ransomes, Sims, and Head, Ipswich, have loaned a 20 horse-power (nominal) engine, specially designed for electric lighting, for the trial on the Embankment, and a 20 horse-power Robey engine, similar to that employed at Billingsgate, is used for the Viaduct. The arrangements in both cases have been carried out by Messrs. Wells & Co. The leading wires are laid in stoneware pipes until they reach the subways, when they are fixed to boards, which are fastened to the brickwork. The wires communicate with the lamps by being passed up through the gas tubes from which the gas is shut off. On the Embankment the alternate gas lamps are fitted with four candles, so that there is a distance of 40 yards between each pair of lamps. The greatest distance between one lamp and the generator on the Westminster side is 700 yards, and 470 yards on the Waterloo side. The photometric power of a lamp will be ascertained by comparison with the 16-candle oil-lamp of Mr. Keates; but the naked light is reckoned at 1,000 candles, therefore as intensity of light diminishes inversely as the square of the distance, the naked candle at 48 feet distance should equal the Keates' lamp at 6 feet distance. A single Gramme's alternating machine is used in both places. These trials are respectively inaugurated by the Metropolitan Board of Works and the City Commissioners of Sewers to get at the true cost and feasibility of Jablochkoff's system.

EDISON'S ENGLISH PATENT FOR THE ELECTRIC LIGHT.—The opposition to Mr. Edison's application for patent No. 4226, dated October 23, 1878, for "Improvements in the method of and means for developing electric currents and lighting by electricity," was heard on the 16th ult., before the Solicitor-General, in his private room at the House of Commons. The opposed and the opposer were both represented by counsel, Mr. Theodore Aston, Q.C., instructed by Messrs. Brewer and Jensen, patent agents, 33, Chancery-lane, appearing on behalf of Thomas Alva Edison, and Mr. Goodeve for John Huddart Russell. The grounds

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of objection lodged were that Edison was not the true and first inventor of the said improvements, or of some of them. The objector, although he had the opportunity given him of doing so, had not lodged any evidence in support of his objection. This is a somewhat unusual proceeding in these opposition cases, as the objector usually wishes to support his reasons for objection by evidence, showing for example, that a patent or manufacture in which he is interested, would by the grant of the application for the patent in question be prejudiced. The interpretation of the Patent Law on the subject of these oppositions is rather peculiar. For instance, it appears that any one who likes may oppose, without showing that he has any apparent *locus standi*, and without giving any security for costs or damages. At the hearing of this case it was stated that Mr. Russell had a pecuniary interest in a patent granted to M. Arnaud. The reason why this gentleman's name was not disclosed earlier appears due to the fact that his patent was not sealed until the 14th ult. M. Arnaud is now looked upon as the real opponent of Mr. Edison, in the case, and had this been known earlier, there is no doubt that M. Arnaud's application for a patent would have been opposed on the part of Mr. Edison. The result of the first day's proceedings was that Mr. Russell was ordered to pay costs of the hearing, and the further hearing of the case was adjourned for a few days, to enable Mr. Russell to produce the evidence which should have been lodged in the first instance. The public must therefore wait yet longer before Mr. Edison's invention can be placed before them. At the adjourned hearing of the case, Mr. Russell's evidence was supplied by Messrs. Russell, Haddon and Knowles, and replied to by Messrs. Adams and Walenn. The decision was to the effect that Mr. Edison's patent should be allowed to proceed and that Mr. Russell should pay all costs incurred.

EDISON'S electric light has been patented in Brazil and other parts of South America, and the firm of Fabri and Chancery have purchased the patent rights for South America. The total cost of his patents is said to be £3,500 thus far, and £20,000 is to be spent on experiments. He expects to get six lights, each equal to a gas jet, from each horse-power of the new dynamo-electric machines.

M. CARRÉ, the carbon electrode maker, is manufacturing 2,000 metres of rod per day, and is extending his works.

A NEW electric lamp, with four carbon rods, arranged parallel, for the electro-pyres is to be tried shortly in Paris.

J. W. STARR, the inventor of electric lighting by incandescence, as patented by King, in England, in 1845, was a very talented young philosophical instrument maker of Cincinnati. He came to England with Mr. King, his agent. Mr. Peabody, the well-known philanthropist agreed to furnish capital to float his invention. Starr constructed a cluster of his lights, enclosed in globes of glass, twenty-six in number, so as to represent the States of the Union. This "United States' Tree," as it was called, excited the admiration of Faraday, and after the exhibition King and Starr went home elated with success. Next morning Starr failed to appear at breakfast, and afterwards was found dead in his bed from over excitement. Nothing further was done with his invention. Starr's caveat, filed in America, claims the use of continuous metallic and carbon conductors for the production of the electric light, "the current being regulated so as to obtain the highest degree of heat without fusing the conductor." Starr's application was rejected in America in 1846, on the ground that his invention was not new. Mr. Edison states that his plan is different from Starr's.

MR. FAHRIG, electrician, Southampton, has, it is said, invented a compound which gives off more light and less heat than carbon under the action of the electric current, and can be made either rigid or flexible.

IN a recent paper in the *Chemiker Zeitung*, Dr. Werner Siemens stated that recently at Bremen a ship with an electric light on her prow, sailed down the river at full speed in the night; and that the Imperial dockyards at Keil are now lit by Jablochkoff's candles.

M. S. MARCUS, of Vienna, is said to have subdivided the electric light before Edison announced his discovery. We rather want to see some of these many reputed subdivisions.

IT has been decided to extend the Jablochkoff electric light to other thoroughfares of Paris, a reduction in the cost having been arrived at.

THE capital of Washington is to be lit electrically by a form of lamp invented by Mr. Rogers, the electrician of the Capitol, which is almost the same as that of Rapieff. It is expected that four dynamo-machines will serve to supplant the 1,300 gas jets now employed.

THE City Commissioners of Sewers, London, have decided to accept the offer of the Gas Light and Coke company to light the London gas lamps at the old rate of 18s. for each ordinary lamp, and 22s. 3d. for each circular lamp, during 1879.

THE electric light was experimentally used at the London Bridge terminus of the London Brighton and South Coast Railway on the evening of Saturday the 21st ult., for lighting the open space between the Main Line and Crystal Palace Line booking offices and the platform barriers. The ordinary Gramme machine and Suisse lamp were employed, the motive power being obtained from an engine some 250 yards distant, which, in addition to working the magneto machine, also pumped up the water required for the general purposes of the station. The machine is the first of its kind made in England, and, together with the lamp, which is said to last about twelve hours without attendance, was supplied by the India Rubber and Telegraph Works Company, of Silvertown, whose electrician, Mr. R. K. Gray, and the railway company's telegraph engineer, Mr. E. J. Houghton, assisted by Mr. Carey, carried out the experiment.

THE INVENTION OF THE TELEPHONE.—*Apropos* of the attempt being made to deprive Professor Bell of the honour of inventing the speaking telephone, we observe in *Nature* a letter from Mr. J. C. Watson, one of the English jurors at the Philadelphia Exhibition, who examined the telephones there exhibited. Mr. Watson describes how he and Sir William Thomson heard Mr. Gray explain his harmonic telephones in chronological order on June 18 (or 25), and on the same day spoke through the speaking telephone of Professor Bell. Mr. Watson further says, "The news of these successful experiments (with Bell's telephone) soon circulated freely, and the day following, or possibly two days afterwards, Mr. Gray came to me and inquired whether the reports of our success with Bell's telephone were correct; and upon receiving from me an affirmative reply, he said that it was impossible, that we had been deceived in some way, that the transmission was by actual metallic contact

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through the wire, and that it was, to use his own words, 'nothing more than the old lover's telegraph.' In reply, I said to him that we had taken every possible precaution against error, that we were both convinced of the reality of Bell's claims, and that Sir William Thomson would report to that effect. He persisted in his statement that the result was impossible, and that we must have been deceived in some way or other. After having had direct knowledge of Mr. Gray's views at that time, I must confess to some astonishment at his claim now made that he anticipated Mr. Bell in the invention of the speaking telephone."

ELISHA GRAY had an immense entertainment in his honour at Chicago the other evening. Telephonic music, telephonic speeches, telephonic songs, telephonic poetry, and telephonic toasts. Big time. Congratulated as being the first and only inventor of the telephone. So was Bell when they gave him a banquet; so was Edison when he had his free lunch. So was Dalbear. So was——By-the-way, who *did* invent the telephone?—*Detroit Free Press*, U.S.

A NEW TELEPHONE.—In the *Comptes Rendus* for Nov. 18, M. C. Ader describes a telephone receiver which gives out sounds audible to a number of by-standers. It consists of a tambour having a diaphragm of parchment paper 15 centimetres in diameter. To the centre of this diaphragm are cemented circularly, six small pieces of tinned iron, each 1 centimetre long by 2 millimetres broad. These armatures are acted on by six small horseshoe electro-magnets, the cores of which are not more than 1 millimetre in diameter, and the limbs are about 6 millimetres in length, with coils in proportion. All these electro-magnets are connected in series, and the line current is passed through them. This current is supplied by a speaking microphone transmitter and three Leclanché cells. M. Ader calls his instrument an *electro-phone*.

"LA FLUTE TELEPHONIQUE."—Our artistic neighbours across the Channel have recently been amusing themselves with a "singing condenser," and now they are performing upon another musical curiosity in the shape of a "telephonic flute." This *petite merveille* is being exhibited at the *Musée Polyphonique*, a new museum established in Paris by M. Delaporte for all kinds of telephones, microphones, and phonographs. This flute, says an enthusiastic writer in *La Correspondence Scientifique*, is one of the most curious instruments that we have heard for a long time. And, God knows, if we are not beginning to accustom ourselves to extraordinary things! Picture to yourself an ordinary flute, furnished near its mouth with a kind of box, intended to hide the secret—a secret which we cannot now reveal. The flutist began the execution of a *morceau de flute*, and then by a simple movement of the thumb of the left hand, without displacement or transition, the sounds of the flute were changed into others quite as harmonious and correct as those of the flute, but which had not the least resemblance to them. They were sounds whose timbre was similar to that of the hautboy, or rather to a cross between the hautboy and the clarionet. With the flute we got the same intonations, the same varied shades, as with the complete instrument. *C'est charmant!*

THE GYMNOTUS AND THE TELEPHONE.—The electric discharge of the gymnotus, or electric eel, has recently been the subject of investigation by M. Marey, a French *savant*, who has demonstrated that it is made up of a series of discharges very like those of the living torpedo. It occurred to M. Marey to employ the telephone in studying the periodicity of these discharges. He therefore placed a healthy torpedo between two sheets of tinfoil connected in circuit with a telephone; and on pricking the electric lobe of the animal, he heard in the telephone a kind of prolonged moan, of which he estimated the pitch. It was that of *me* in the tonic scale, corresponding to 330 vibrations per second. The ordinary discharge of the torpedo is too brief to give any other sound than a crack.

"THE VOICE OF THE EARTHQUAKE."—Some time ago we suggested to Prof. Palmieri the use of the microphone in connection with a seismograph to render the vibrations of the earth at Vesuvius audible; and now we hear that the learned Professor has adopted the plan. In a recent note to the Italian journal *Roma* he says, "The seismograph permits an attentive observer to note the vibrations of the ground; by aid of a microphone transmitter and a telephone receiver, the ear can now perceive the noise of these vibrations. I have verified this fact in June last with a microphone sent by M. Pugnetti, inspector of telegraphs at Rome. The microphone is then a precious auxiliary to the seismograph. Professor Michel-Etrenne de Rossi, with a microphonic apparatus much more delicate, has made surprising experiments on this subject in his observatory at Vesuvius. His results will be made known in a periodical called *The Italian Vulcan*. Professor Rossi has been able at each manifestation of an irruption in Vesuvius to hear, so to speak, the palpitation of the earth."

THE MICROPHONE AND THE SPIRITS.—Professor Palmieri's success in hearing the "voice of the earth," suggests to us that it might also be used as an aid to those lay utterances of the unseen universe commonly called spirit rapping. Professor Hughes has investigated the source of sound in the telephone by its means. Why not also investigate the source of sound in the table? A skilfully concealed microphone might help to solve that vexed question of the authenticity of spiritualism. We recommend it to the use of those enquiring *savants* and Russian barons who wish to fathom that interesting mystery.

M. VAREY'S form of transmitting microphone which was recently tried with much success between Paris and Versailles, has also been tried by Major Webber in this country, over sixty miles of wire. Although there was a considerable induction noise on the wire the microphonic voice could, we believe, be distinctly heard. Varey's form consists of a pencil microphone in circuit with the primary of an induction coil, the secondary being in circuit with the line.

"*Le Microphone et ses Applications en Medicine*," by Dr. Gibours, is the title of a pamphlet just published by Balliere & Sons, Paris.

M. BREGUET, the well-known electrician; M. Grandeau, the physicist, whose recent researches on the influence of electricity on vegetation we summed up in the TELEGRAPHIC JOURNAL for September 15, 1878; M. Menier, the chocolate and cable manufacturer, and M. Gauthier-Villars, formerly inspector of telegraph lines, now librarian of the Bureau of Longitudes, have been made Officers of the Legion of Honour; while M. Deleuil, mechanician; M. Dunod, editor of the *Annales Telegraphique*; M. Thomasset, constructor of telegraphic testing instruments; M. Bontemps, chief of the Parisian pneumatic system, and M. Baudot, inventor of the Baudot multiple apparatus, have been created Chevaliers of the same Order. M. Jablochkoff

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was awarded a gold medal for his system of electric lighting.

THE "SINGING CONDENSER" has recently re-appeared at Paris, where it is generally introduced as an invention of Mr. C. Varley instead of Dr. Wright. In a description of Reiss' receiving telephone, given in 1867 in Ferguson's *Electricity*, the following passage occurs:—"Suppose a person to sing a note at the mouthpiece which produces 300 vibrations a second, the circuit is broken at the bladder 300 times, and the iron wire ticking at this rate gives out a note of the same pitch. The note is weak, and in quality resembles the sound of a toy trumpet. Dr. Wright uses a receiving apparatus of the following kind:—The line current is made to pass through the primary coil of a small induction coil. In the secondary circuit he places two sheets of paper, silvered on one side, back to back, so as to act as a condenser. Each current that comes from the sending apparatus produces a current in the secondary circuit, which changes and discharges the condenser, each discharge being accompanied by a sound like the sharp tap of a small hammer. The musical notes are rendered by these electric discharges, and are loud enough to be heard in a large hall."

This was the last word on telephony in 1867. Nine years later the speaking telephone was invented, and we hear a great deal on the subject to-day; but yet they had done something then which should not be overlooked.

"*The Exchange Telegraph Recorder*."—This novel publication has been started by the Exchange Telegraph Company in order to supply those outside the radius of the company's telegraph system who are interested in the prices of stocks and shares, with a continuous reliable daily record of the fluctuations on the London Stock Exchange. The prices quoted are those obtained in the various markets by the company's special reporters, for telegraphic and transmission over the company's lines. In addition to the daily fluctuation on the London Stock Exchange, all other current prices passing over the company's system will be given.

M. LIAIS, director of the Rio de Janeiro Observatory, has begun to determine the longitude of Rio, west of Greenwich, by means of the telegraph.

SCHELLEN, the well-known author of a German work on telegraphy, has recently published one on the Electric Light.

WE regret to have to record the death by violence, of a promising young telegraphist, Mr. William Anderson, at Canea, in the Island of Crete, on the evening of the 14th ult. Mr. Anderson was the superintendent of the Eastern Telegraph Company at that place. He was a nephew of Sir James Anderson, managing director of that company, and was much respected and esteemed by all classes and creeds. His remains were found outside the city gates along with those of a native clerk with whom he had been walking. The murderers have not yet been traced, but Her Majesty's Consul, Mr. Sandwith has proceeded to Canea to investigate the outrage.

New Patents.

5041. "Thermo-electric piles and generators." J. M. E. LUDRE. Dated Dec. 9.

5076. "Electro-magnetic and magneto-electric machine." J. H. JOHNSON (communicated by E. Bertin and F. E. de Mersanne). Dated Dec. 11.

5093. "Improving apparatus for composing, transmitting and deciphering secret telegrams." H. J. HADDAN (communicated by Schacher et Cie.). Dated Dec. 12.

5139. "Apparatus for the production and application of electricity for lighting and other purposes." W. B. BRAM. Dated Dec. 14.

5152. "Improvements in electric lamps or lights, and in the electrodes, and appliances connected therewith. G. WHYTE. Dated Dec. 16.

5165. "Electric lamps." A. M. CLARK (communicated by L. Reynard). Dated Dec. 16.

5181. "Construction and working of telephones and apparatus connected therewith." C. J. WOLLASTON A. SCOTT. Dated Dec. 17.

5183. "Improvements in and relating to electric lighting apparatus." W. R. LAKE (communicated by J. B. Fuller). Dated Dec. 17.

5197. "Producing and regulating electric light." H. WILDE. Dated Dec. 18.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

902. "Transmitting light." M. T. NEALE. Dated March 5, 1878. 6d. This consists in a means of distributing the light from an electric lamp, or other powerful source, to different places by means of pipes and reflectors of non-absorbent material. The interior of the pipes and reflectors should be enamelled, glazed, or coated with reflecting metals. Main and branch pipes are employed.

1079. "Telephonic apparatus." A. BREGUET, CORNELIUS ROOSEVELT, and GABRIEL LIPPMANN, Paris. Dated May 28, 1878. 6d. This describes Breguet's electro-capillary telephone, in which the voice imparts motion to contact surfaces of mercury and dilute sulphuric acid, thereby producing corresponding currents of electricity which travel along the line, and reproduce the sounds on a similar apparatus at the distant end. See TELEGRAPHIC JOURNAL for April 15, 1878.

1155. "Telegraphs." R. THEILER, J. E. THEILER, and MEINRAD THEILER. Dated March 23, 1878. 6d. This consists in multiplying the mechanical effect of telegraph or other electric currents by means of air or other gaseous pressure. The pressure may be applied as a continuous blast, whose intensity is controlled by causing the electric current to regulate the orifice, or it may be applied by causing the current to vary the pressure in an enclosed chamber by regulating the outlet. The motion is obtained by means of an elastic diaphragm forming a side of the chamber, and rising or sinking with the air pressure inside. Instead of providing an outlet for the gas, two diaphragms of suitable relative proportion may be used. By moving one of these under the action of the current the other will respond and actuate the recording pen, which may be a siphon, stylus, or an ordinary Morse marker.

The patent also includes a key, which instead of sending currents of unequal duration, and spacing them equally, sends equal short currents and spaces them unequally. The rocking lever of this key may be of the usual shape, and its movement limited in the usual way by a contact stud in front and another at the back. This motion is magnified by additional suitable leverage, and transmitted to a contact-maker. To this contact-maker a click and a suitable grinding piece are attached, which allow it to move only in a certain line when going downwards, and force it to move in another line when going back. This contact-maker therefore rubs one contact in going down, and a different one in going up. But before changing from one contact to the other it touches neither of the two, and the circuit is consequently broken by suitable connections with the line, earth, and battery; this key will therefore send a current of one polarity going down, and one of the opposite polarity going up.

1195. "Electric conductors." H. C. SPALDING, New Jersey. Dated March 26, 1878. 2d. This consists in

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the employment of conducting liquids, enclosed in suitable non-conducting tubes, as conductors of electricity. *Not proceeded with.*

1196. "Electric conductors." H. C. SPALDING, New Jersey. Dated March 26, 1878. 6d. This consists in employing thin strips of metal conductors, enclosed in insulating tubes or coatings of enamel or glass.

1228. "Electric telegraphs." HENRY WILDE. Dated March 28, 1878. 6d. This consists in generating simultaneously a number of separate line currents by causing the alternating currents from a dynamo-electric machine to traverse the coils of a number of small electro-magnets which experience reversals of their magnetisation simultaneously with the reversals of the magnetism of the armature of the machine, and intense secondary currents are generated in secondary wires surrounding these magnets. The alternating currents from these secondary coils are made to give audible signals by a Morse key, in the manner described by the patentee in patent 3196, of 1869. The patent also describes a dynamo-electric generator, which consists of a Pacinotti armature (which consists of a broad and thick ring of iron, recessed at equal angular distances round its periphery for the reception of coils of insulated wire), surrounded with a circle of inducing electro-magnets placed at equal angular distances from each other. The circle is formed of an even number of magnets corresponding to the number of coils in the armature, having N. and S. poles alternately. Part of the armature coils feed the external electro-magnets and part perform the external work.

1248. "Insulators for telegraph purposes." JOSEPH OPPENHEIMER. Dated March 29, 1878. 4d. This consists in protecting insulators from the destructive effects of lightning by fitting a lightning discharger within the insulator itself. For this purpose, the iron bolt of the insulator is made to present a pointed metal discharger to the underside of the top of the iron hood of the bell. The bell is open at the top for this purpose. The discharge takes place between the hood and the point, and thence reaches earth by the bolt and the lightning rod of the post.

City Notes.

Old Broad Street, Dec. 30th, 1878.

The Eastern Telegraph Company (Limited) announce the payment of an interim dividend of 2s. 6d. per share on the ordinary shares of the company, free of income tax, on the 14th January, in respect of profits for the quarter ending 30th September, 1878, and that a dividend of 3s. per share on the preference shares, less income tax, for the quarter ended 31st December, 1878, will be paid on the same date.

The directors of the Eastern Extension Telegraph Company (Limited), have declared an interim dividend for the quarter ending 30th September last of 2s. 6d. per share, or at the rate of 5 per cent. per annum free of income tax, payable on the 15th January.

On the 23rd ult., the Western and Brazilian Telegraph Company (Limited), notified that their Cable between Pernambuco and Bahia, was repaired, thus restoring direct communication by cable between Pernambuco, Rio Janeiro, Uruguay, the Argentine Republic, Chili, and Peru.

The *Times* reports that the Franco-American cable scheme is now to be brought forward.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 56½-57½; Ditto, Preferred, 82½-83½; Ditto, Deferred, 31-32; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅜-6⅝; Cuba, Limited, 8¼-8¾; Cuba, Limited, 10 per cent. Preference, 15-15½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 9½-10; Direct United States Cable, Limited, 1877, 11¼-11½; Eastern, Limited, 7⅛-7⅜; Eastern, 6 per cent. Debentures repayable October, 1883, 102-105; Eastern 5 per cent. Debentures repayable August, 1887, 100-103; Eastern, 6 per cent. Preference, 10¾-11; Eastern Extension, Australasian and China Limited, 6⅛-7⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 103-105; German Union Telegraph and Trust, 8-8½; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10⅛-10⅜; Great Northern, 7¼-8⅛; Indo-European, Limited, 19-20; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 8¼-9⅛; Reuter's, Limited, 9½-10½; Submarine, 215-220; Submarine Scrip, 1¾-2; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 7¾-8¼; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 2¼-2⅜; Ditto, 6 per cent. Debentures "A," 87-92, Ditto, ditto, ditto, "B," 84-88; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds; 114-118; Ditto, 6 per cent. Sterling Bonds, 100-102; Telegraph Construction and Maintenance, Limited, 28¼-29½; Ditto, 6 per cent. Bonds, 100-103; Ditto, Second Bonus Trust Certificates, 2⅜-2⅝; India Rubber Co.,—.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,102,420.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
November, 1878	51,090	12,753	2,600	1,002	17,030*	37,170	25,280	16,587	... ...	9,549	2,200	... ...	4,676
November, 1877...	47,890	12,233	2,859	885	12,920	38,439	20,794	18,206	... ...	9,817	1,800	10,368	4,292
Increase	3,200	520	... ...	117	4,110	... ...	4,486	... ...	... ...	... ...	400	... ...	384
Decrease	... ...	... ...	259	... ...	... ...	1,269	... ...	1,619	... ...	268	... ...	.. ...	... ...

* Estimated δ Not published.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

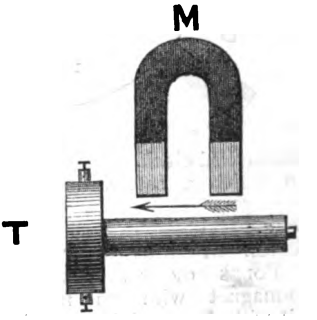
VOL. VII.—No. 143.

MR. HERRING'S INSTRUMENT.

THE letter from a correspondent which we publish in the present number of the Journal contains remarks which have much truth in them. They are evidently the opinions of a skilled practical telegraphist, who from long experience is well qualified to know the value of any improvements that may be suggested in the existing forms of telegraph instruments. The opinion of the writer of the letter is not, of course, necessarily a strictly correct one, though the arguments seem plausible in the main. In the case of Mr. Herring's printing telegraph which we described in our issue for Dec. 15, we have had opinions as to its merits expressed by men who are well known as eminent scientific experts, and whose names are household words in the electrical world, and now we also have the opinion of a practical telegraphist, which, as we desire only to be fair, we would recommend to the notice of our readers. The general public and probably also inventors give their verdict on this question on the side of the eminent scientific authorities who have been invoked. But a mere blind following of the opinion of scientific experts and men of name is not to be upheld. The judgment of such men on particular points is practically law, and correctly so; and their opinion on subjects which, to a certain extent, lie outside their own sphere of work, in many cases is also extremely valuable, simply from the fact that their natural astuteness enables them in many cases to see clearly at first sight the exact facts of the case; but this does not make their decision on all matters connected with their profession an infallible one. A man may be a perfect pianist, but it does not therefore follow that he is competent to say whether a violinist handles his bow properly, or whether a new form of bow is more suitable for the purpose than those previously used. In order to determine that matter it is absolutely necessary for him to possess a knowledge of the instrument in question. So it is in telegraphy; a thorough knowledge of the systems, that are being attempted to be improved, is absolutely necessary before a correct opinion can be arrived at, and this can only be obtained by lengthened experience. We do not mean to say that it is useless therefore to attempt to introduce improvements into systems of which a thorough knowledge is not possessed, but there is perhaps, a certain tendency in inventors to feel convinced that they know much better what improvements are wanted than those who have had to deal with the object which the inventor is desirous of remodelling or superseding. On the other hand, there is equally a tendency the other way, viz.: for those in authority to reject any proferred aid from outsiders, a natural inertia to suffer change, and perhaps also a feeling of wounded professional egotism because the improvement in question did not originate with them. Now, the fact that these discordant tendencies exist on both sides, seems to us to call for a competent and independent third party which would mediate between inventors and telegraph officials. We have already advocated such a course in pointing attention to the Commission of experts appointed to recommend inventions to the authorities, in France and other Continental countries, and it still appears to us to be the link required for the harmonious interaction of outside inventors and the Government telegraph service of England.

A CURIOUS TELEPHONIC EXPERIMENT.

A SINGULAR experimental effect, of special interest just now from its possible bearing on the theory of the source of sound in the Bell telephone, has just been observed by Mr. Stroh, the well known mechanician. If a telephone T, with the circuit of its coil left open, be held to the ear, and a powerful magnet M be moved gently up and down along the length of the magnet, as shown by the arrow, and at a distance of an inch or two from it, a faint breathing sound will be heard; the recurring pulses of sound keeping time with the up and down motion of the magnet. The sound may be aptly compared to the steady breathing of a child, and there is a striking resemblance between it and the microphonic sounds of gases diffusing through a porous septum as heard by Mr. Chandler Roberts.



We understand that Prof. Hughes is investigating the cause of this curious sound by help of the microphone.

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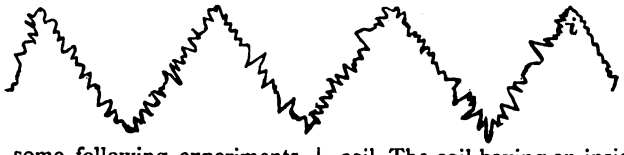
EXPERIMENTAL INVESTIGATIONS BY AID OF THE TELEPHONE AND MICROPHONE.

By PROF. D. E. HUGHES.

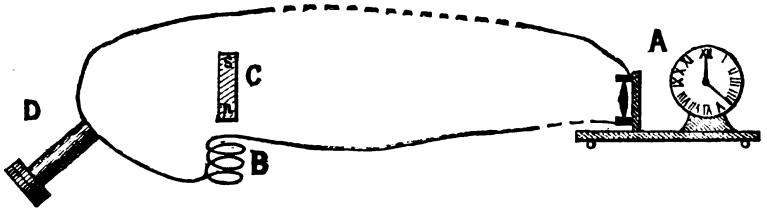
INDUCED CURRENTS.—Up to the present time the microphone has only been used in connection with voltaic currents, but it has also a remarkable power when connected with an ordinary telephone to detect induced currents too feeble to be observed upon a galvanometer, and also too feeble to be heard by the telephone alone. In order to detect feeble voltaic or induced currents upon the telephone, unaided by the microphone, we should construct a De la Rive's Rheotome, in order that by sufficiently rapid interruptions and contacts, a sufficient number of vibrations of the diaphragm may be obtained to produce a tone sensible to the human ear.

The microphone, however, when used with a clock or any other source of sound, not only transmits the regular beats of the clock, but all its timbre and its infinite varieties. Thus, a clock which beats half seconds, would in a second give four complete waves of sound, and superposed on these an infinite number of variations due to the timbre of the source of sound, consequently the waves of electricity transmitted instead of taking a uniform curve, would be represented graphically thus :—



And we shall see in some following experiments how fully it serves the object intended, giving them a power of research into feeble induced currents that we have hitherto not possessed.

In the following first series of experiments no voltaic currents were used. The microphone in a distant chamber being connected direct to the coil or organ under investigation, thence to the telephone and return wire, thus :—



A, microphone and clock.

B, coil in which a natural magnet C, can be introduced.

D, telephone.

I.—INDUCTION BY MOVEMENT OF A MAGNET NEAR THE POLES OF AN ELECTRO-MAGNET.—An electro-magnet with an iron core being put in circuit with the receiving telephone, no battery being employed, and a magnet made to touch the iron core, distinct tones could be heard in the telephone, confirming what had already been observed by many experimenters; but if the magnet was moved to ¼ inch distance, and oscillated through a small space, no sound could be heard, consequent upon the current generated being feeble and not of sufficient rapidity to produce an audible sound. If, however, under these conditions, one of the wires connecting the electro-magnet to the telephone line was cut, and the ends put together again in a loose contact, with but a slight pressure, so that by a constant vibration of the first wire, the circuit was made and broken with great rapidity, clear crackling tones could be heard by simply holding the magnet near the electro-magnet, and it is impossible to hold with the hand the magnet steady enough not to produce innumerable induction currents, plainly perceptible on the telephone. That these currents are due to the unstable position of the magnet whilst in the hand, is proved by firmly fixing the magnet in a strong mechanical support, when the sounds are no longer audible.

II.—In place of the vibrating contact above described, the transmitting microphone with clock, but without battery, was employed; louder sounds could now be heard, or rather the beats of the clock, by simply moving the natural magnet near the poles of the electro-magnet. If we replaced the electro-magnet by a simple coil the clock could be distinctly heard when the magnet passed near to the coil, but more so when the magnet was introduced into the coil. The coil having an inside diameter of 2 inches, allowed the magnet to be drawn through it easily without touching it. It was remarkable how continuous this induced current became when we moved the magnet slowly through the coil, thus for a magnet only 6 inches long, we obtained a continuous current during a slow passage of 3 seconds. If the magnet moved quickly, sounds were equal to 1 Daniell element; but when the magnet moved very slow the sounds were faint but continuous. This arrangement proves itself to be a most sensitive and useful means of demonstrating feeble induced currents—too feeble to be perceived by any other known means.

III.—If in place of moving the magnet near the coil, we move the coil itself near the telephone to which we are listening, we then hear distinctly the clock upon the microphone; but if we suppress the microphone we hear no sounds or production of induced currents by the movement of the coil near the telephone.

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IV.—If we suppress the coil, having simply in circuit the microphone and telephone (without battery), we can hear the clock sounds, simply by moving a strong bar magnet near the telephone to which we are listening, and we have thus obtained articulate sounds which were perfectly understood.

Here we have the remarkable fact, that the coil of the telephone that produces the current, also, at the same time, by aid of the variations produced by a microphone, serves to reproduce upon its diaphragm the sounds transmitted to it from a distant station.

V.—The above experiment may be varied by joining the microphone circuit direct to a coil of an electro-magnet, and the telephone to a secondary coil surrounding the primary coil. Thus the microphone is in the primary circuit, and the telephone in the secondary, both direct and without battery. If now we move a natural magnet near the two coils, we hear perfectly the sounds transmitted by the microphone. We have here simultaneously double induced currents, re-acting on each other directly in proportion to the innumerable variations of resistance introduced into the primary circuit by the microphone.

VI.—Instead of using a coil and magnet we may connect two telephones in direct circuit with the microphone, and upon pressing gently upon the diaphragm of one, and listening with the other, we hear distinctly the sounds transmitted by the microphone, but not those due to the movement of the finger upon the diaphragm of the telephone; and with a diaphragm of thin charcoal iron, the slightest pressure of the finger upon it, is sufficient to make the microphone sounds audible, and if this pressure is slightly but continuously varied, we hear the microphone sounds as continuously.

Many similar experiments could be cited, but we deem that the ones already mentioned are sufficient to prove that we possess in the telephone and microphone powerful aids to the investigation of feeble magneto currents. In some following experiments we will show how remarkable are its powers in relation to currents induced by voltaic electricity.

THE BRUSH ELECTRIC LIGHT.

THE dynamo-electric machine of Mr. Brush, which was patented in England last year (patent No. 2,003) is attracting considerable attention just now in America, where it divides public favour with the Wallace-Farmer machine (see TELEGRAPHIC JOURNAL, Vol. 6, p. 431), in much the same way as the Siemens' machine rivals the Gramme in this country. It is neat and simple in construction, readily open to inspection, and requires no special attendance when running. Fig. 1 is a view of the machine as it stands, and fig. 2 is a longitudinal section of it along the centre line, while fig. 3 is a vertical section across the middle. It will be seen that it consists essentially of two horse-shoe magnets H H, placed with their like poles N N, S S, opposite each other, but far enough apart to allow a coiled armature A to rotate between in the usual manner, the currents being drawn off by hard metal brushes rubbing against a commutator E, on the shaft to which the armature coils are connected The novelties of the machine consist in the arrangement of the armature and the commutator. The armature A (fig. 1 and 2), consists of a soft iron wheel, preferably cast, with a heavy rim, fixed by the hub B to the shaft C, which is driven by a belt on the pulley D. The continuous rim of this wheel is niched out at regular intervals, and insulated copper wire is coiled into each niche in the same direction for all. In the machine represented there are eight separate coils, each occupying a niche in the rim. In the Gramme armature the iron ring has a uniform cross section in every part; but Mr. Brush claims for the niched ring that the projecting parts between the coils are brought closer to the poles of the electro-magnets N, S, where they experience stronger induction, and that these exposed surfaces help to radiate away the heat generated in the ring by the rapid changes of magnetism which take place in it. It is a peculiar feature, too, of these American machines, the Brush and Wallace-Farmer, that the cores of the armature and electro-magnets are sometimes perforated, as shown in fig. 1, by cylindrical holes, for the double purpose of getting rid of superfluous material and increasing the heat radiating surface. Another improvement patented by Mr. Brush consists in insulating from one another, either wholly or in part, the two halves of the armature core which would be obtained by splitting it in its own plane. The object of this device is to prevent the electric currents induced in the core itself by its motion in the magnetic field from circulating entirely across the rim. By splitting up the rim in its own plane, and interposing insulating material between the halves, these currents (which traverse the rim in a direction at right-angles to the direction of its motion) are cut off and confined in their flow to each half of the cross section, and their heating effect diminished. Instead of employing a layer of insulating substance between the halves of the rim, Mr. Brush also cuts a deep narrow groove round the periphery of the latter, and in this way, without entirely splitting the rim, he inserts an insulating layer of air, and secures the advantages which he aims at. A second groove (shown in fig. 1) is cut round the *sides* of the rim, for a similar purpose.

The arrangement of the commutator is sketched in figure 4. Each pair of opposite coils on the armature A are connected together, the end of one being joined across to the beginning of the other, as shown at 3 and 7; and the other ends being connected respectively to contact segments S 3 and S 7 of the commutator E carried by the shaft. These contacts are insulated from each other, and form the positive and negative poles of the two coils joined together. Brush contacts (F F, fig. 3) rubbing against these as they revolve, conduct away the current generated. The two segments, S 3 and S 7, corresponding to coils 3 and 7 of the armature, hold a position on the cylinder E in advance of those of the preceding coils, S 2 and S 6, to the same angular extent that the coils 3 and 7 are removed from 2 and 6 on the armature, so that the brushes draw off currents of equal strength from each succeeding pair of coils and in this way maintain the uniformity of the resultant current. When a coil is passing the "neutral" points, at right-angles to the line joining the poles of the inducing magnets N S, the plates F are in contact with the insulating material inserted between the corresponding contacts on the cylinder E, and thus the coil in question, which is

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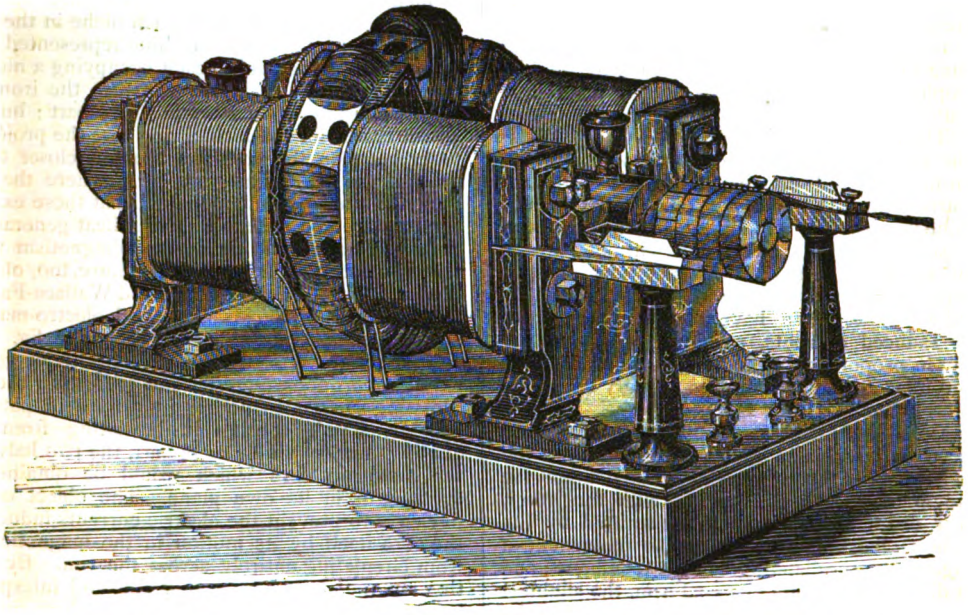

FIG. 1.

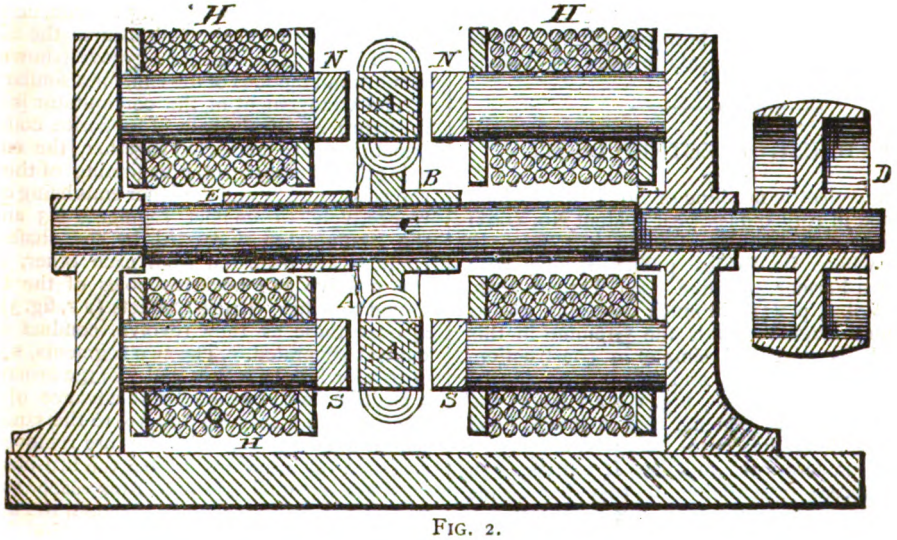

FIG. 2.

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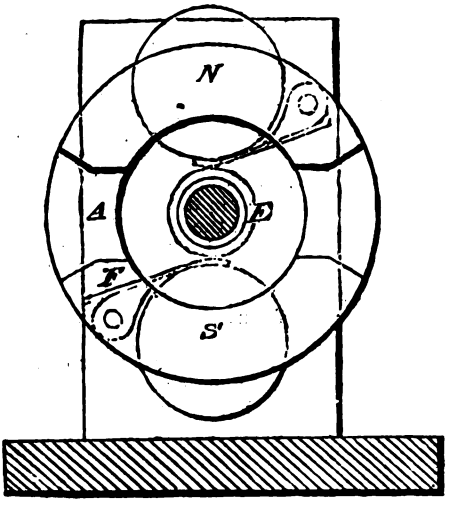

FIG. 3.

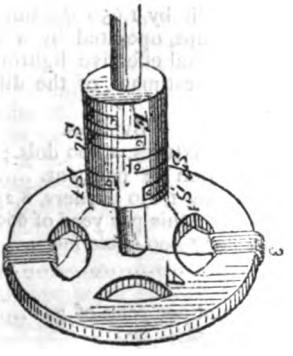

FIG. 4.

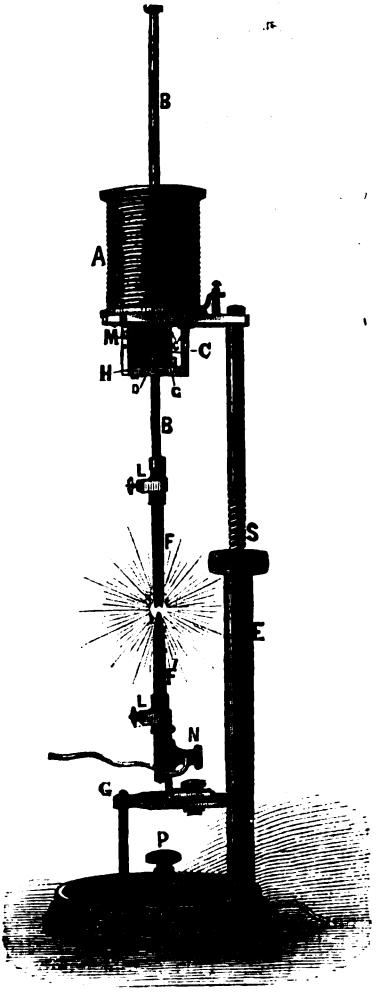

FIG. 5.

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for the time inactive, is cut out of circuit in order that it may not shunt off part of the current generated by the active coils. In fact, the insulating spaces are made experimentally so wide that each coil is cut out of circuit except when it is producing its maximum of current. In practice it is found that the neutral points of the armature in motion are considerably in advance of their theoretical position, perhaps because some time is required to saturate any parts of the armature with magnetism, so that it is really carried beyond the points of greatest and least magnetic intensity of the field before attaining its maximum or minimum charge. The proper position of the contacts on the cylinder with respect to the true neutral points is determined experimentally by shifting the former until, on breaking contact between the brush and the cylinder, the absence of sparking for the coil in question shows that it is inactive. Each pair of bobbins, of course, form a single dynamo-electric element, and the rapid discharges from the pairs in succession, produce the effect of a practically uniform current. It is worthy of mention that the copper contact segments S, are so fixed to the cylinder E that they can be readily replaced when worn down; and that the insulating spaces between these, over which the rubber passes, are faced with copper to keep up the uniformity of material.

The electro-magnets H H, are excited by the whole or a portion of the current from the armature, after the manner usually followed in dynamo-electric machines. The working holes of these magnets consist, as seen in figs. 1, 2, and 3, of iron segments N S, which embrace the armature for the most part of its circumference and spread their inductive influence. Obviously the opposite segments N N, and S S, may be united at their outer edges so as to enclose the armature yet more, an arrangement adopted in the small Brush machines.

We should specially mention, in passing, the means whereby Mr. Brush provides a permanent magnetic field in dynamo-electric machines, whether the external circuit be open or closed, a valuable property in electrotyping, where varieties of external work, and currents of polarisation seriously affect the magnetic field when it is in circuit with the latter. It consists in *diverting* from the external work a portion of the current and using it alone, or in connection with the rest of the current, to work the field magnets. For electro-plating the latter plan is preferable. In both of these cases, whether the external circuit is open or closed, the magnetic field will remain sufficiently strong for the purpose in view. This is effected by winding the cores of the field magnets with an extra circuit, having a resistance high in comparison with that of the external circuit, so that the portion of current which it diverts from the latter may not materially reduce the working current.

We come now to the Brush electric lamp which is shown in fig. 5. It consists of a stand E, supporting the regulator A, and the two carbons F F'. These carbons, of which F is positive, and F' negative, are fixed by clamp sockets L L. By a slide G, the position of the lower carbon can be set with respect to the upper. P and N are terminals to which are connected the leading wires from the machine. The carbons are coated with copper or nickel to prevent undue wastage of their substance when emitting light. The current from P passes up the support E with its adjustible screw socket S, and through the coil of the regulator A; thence down the metal rod B and through the carbons, thus completing the circuit. The regulator is an ingenious electro-magnetic arrangement, somewhat similar to that obtaining in the Wallace-Farmer lamp. It consists of a hollow electro-magnet A, enclosing a hollow soft iron core C, which again encloses the rod B, which carries the upper or moveable carbon. Now the hollow core C is made to control the downward motion of the rod B by the following device. The core C is supported within the coil A partly by the upward push of a spring C', and partly by the upward pull of the electro-magnetism of the coil. In this position it slightly tilts up a loose ring or washer D which encloses the rod B, so as to cause the washer to gently clutch B, and hold it tight. When the widening of the arc weakens the current in the coil A, the upward electro-magnetic pull on the core C is lessened, and the latter tends to descend. The washer is thus tilted less strongly, and its clutch on the rod is loosened. The rod therefore slips downward until the increasing strength of current thereby produced arrests its progress. In this way the regulation is effected. Should the rod from any cause slip so far as to bring the carbons into contact or too near, the washer is tilted and the rod forcibly pulled back by the full strength of current, a small stop G being set to catch the washer, and prevent the rod being pulled up to far.

The committee of the Franklin Institute reported very favourably on the Brush machine. They considered it well adapted for lighting purposes, and easy of repair, while giving currents of widely different electro-motive force at will. We learn from America that Brush's system is being introduced into a number of large cloth factories in the United States, one of which, 380 feet long by 220 feet wide, now lit by 1,650 gas-burners, will be lit by 20 Brush lamps, operated by a single machine, with the same total effective lighting power. The following is an estimate of the difference in cost per year:—

By Gas.	Dols.
Burners, pipes, fixtures, 1,500 dols.; interest and depreciation 12 per cent.	180
Gas consumed by 1,650 burners, 8,250 cubic feet per hour; this per year of 660 hours, at 2 dols. per 1,000 cubic feet	10,890
Repairs, &c.	50
Total per year of gas ..... Dols.	11,120

By Electricity.	
One large Brush machine, 3,250 dollars; lamps, 250 dols.; total plant, 3,500 dols.; interest and depreciation 15 per cent. ...	525
Driving power—12 horse-power taken from 100 horse-power engine which drives the works; the cost practically nothing, but estimating at cost of special engine.....	76
Carbon, 4 cents. per hour per lamp.....	528
Wages of one attendant, 25c. per hour	165
Small expenses, oil, waste, &c., estimated at	100
Total of electricity ..... Dols.	1,394

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CIRCUMSTANCES INFLUENCING THE EFFICIENCY OF DYNAMO-ELECTRIC MACHINES.*

By Profs. Edwin J. Houston and Elihu Thomson.

During the recent competitive trials made at the Franklin Institute, as to the relative efficiency of some different forms of dynamo-electric machines, the authors have been entrusted with the work of determining the relations between the mechanical power consumed, and the electric and thermic effects produced, took the opportunity thus afforded, to make a careful study of many interesting circumstances which influence the efficiency of these machines.

It is proposed in the present paper, to select from the many circumstances thus noticed, a few of the more interesting, reserving the others for a future consideration.

It will readily be understood, from the comparatively new field in which we had been working, no reliable data of the electrical work of these machines having before been obtained, that difficulties constantly arose owing to necessary conditions of operation, and new developments as to the behaviour of the machines under varied conditions, were constantly met.

A convenient arrangement of the particular circumstances we are about to discuss may be, 1st, Those affecting the internal work of the machine; 2nd, Those affecting the external work, and 3rd, The relations between the internal and external work.

The mechanical energy employed to give motion to a dynamo-electric machine is expended in two ways, viz., 1st, In overcoming friction and the resistance of the air; and, 2nd, In moving the armature of the machine through the magnetic field, the latter of course constituting solely the energy available for producing the electrical current. The greatest amount of power expended in the first way, was noticed to be about 17 per cent. of the total power employed. This expenditure was clearly traceable to the high speed acquired by the machine. The speed, therefore, required to properly operate a machine is an important factor in ascertaining its efficiency.

The above percentage of loss may not appear so great, but when it is compared with the total work done in the arc, as heat, constituting as it did in this particular instance over 50 per cent. of the latter, and about 33 per cent. of the total work of the circuit, its influence is not to be disregarded.

In another instance, the work consumed as friction was equal to about 80 per cent. of that appearing in the arc as heat, while in the Gramme machine experimented with, this percentage fell to 20 per cent. of that which appeared in the arc as heat, and was only about 7 per cent. of the total power consumed in driving the machine.

In regard to the second way in which mechanical energy is consumed, viz.: in overcoming the resistance necessary to move the armature through the magnetic field, or in other words, to produce electrical current, it must not be supposed that all this electrical work appears in the circuit of the machine, since a considerable portion is expended in producing what we term the local action of the machine, that is local circuits in the conducting masses of metal, other than the wire, composing the machine.

The following instances of the relation between the actual work of the circuit, and that expended in local action, will show that this latter is in no wise to be neglected. In one instance an amount of power somewhat more than double the total work of the circuit was thus expended. In this instance also it constituted more than five times the total amount of power utilised in the arc for the production of light. In another instance it constituted less than one-third the total work of the circuit, and somewhat more than one-half the work in the arc.

Of course work expended in local action is simply thrown away, since it adds only to the heating of the machine. And since the latter increases its electrical resistance, it is doubly injurious.

The local action of dynamo-electric machines is analogous to the local action of a battery, and is equally injurious in its effects upon the available current.

Again, in regard to the internal work of a machine, since all this is eventually reduced to heat in the machine, the temperature during running must continually rise until the loss by radiation and convection into the surrounding air, are eventually equal to the production, and the machine will at last acquire a constant temperature. This temperature, however, will differ in different machines according to their construction, and to the power expended in producing the internal work, being, of course, higher when the power expended in producing the internal work is proportionally high.

If therefore a machine during running acquires a high temperature when a proper external resistance is employed, its efficiency will be low. But it should not be supposed that because a machine when run without external resistance, that is on short circuit, heats rapidly, that inefficiency is shown thereby. On the contrary, should a machine remain comparatively cool when a proper external resistance is employed, and heat greatly, when put on short circuit, these conditions should be regarded as an index of its efficiency.

As a rule the internal resistance of dynamo-electric machines is so low that to replace them by a battery, the latter, to possess an equal internal resistance, would have to be made of very large dimensions, so that the efficiency of Dynamo-Electric Machines, cannot be stated in terms of battery cells as ordinarily constructed.

In regard to the second division, viz., the external work of the machine, this may be applied in the production of light, heat, electrolysis, magnetism, &c.

Where it is desired to produce light, the external resistance is generally that of an arc formed between two carbon electrodes; the resistance of the arc is therefore an important factor in determining the efficiency. To realise the greatest economy, the resistance of the arc should be low, but nevertheless should constitute the greater part of the entire circuit resistance.

In some of our measurements the resistance of

* Paper read before the American Philosophical Society, Nov. 1st, 1878.

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the arc was surprisingly low, being in one instance 54 ohm., and in another ·79 ohm. It was, however, in some instances as high as 3·18 ohms.

It may be noted as an interesting fact that where the greatest current was flowing, the resistance of the arc thereby produced was low. This is undoubtedly due to higher temperature and increased vaporization from the carbons. In this latter case also the greatest amount of light was produced.

The amount of work appearing in the arc as measured by the number of foot pounds equivalent thereto, is not necessarily an index of the lighting power. In two instances of measurement, the amount of energy thus appearing in the arc was equal, while the lighting powers were proportionately as three to four. This apparent anomaly is explained by considering the resistance of the arc, it being much less in the case in which the greater light was produced. The heat in this case being evolved in less space, the temperature of the carbons, and therefore their light-giving powers, was considerably increased.

A few remarks on the economical production of light from an electrical current may not be out of place. The light emitted by an incandescent solid will increase as its temperature is increased. In the voltaic arc the limit to increase of temperature is in the too rapid vaporization of the carbon. Before this point is reached, however, the temperature is such that the light emitted is exceedingly intense. No reliable method of measuring the temperature of the arc has as yet been found.

A well known method of obtaining light from electrical currents is by constructing a resistance of some material such as platinum, having a high fusing point and heated to incandescence by the passage of a current. When platinum is employed the limit to its increase of temperature is the fusing point of the platinum, which is unquestionably but a fraction of the temperature required to vaporize carbon. Were the falling off in the amount of light emitted merely proportional to the decrease in temperature, the method last described might be economical. Unfortunately, however, for this method, many facts show that the decrease in the light emitted is far greater than the decrease of the temperature. Most solids may be heated to 1000° F., without practically emitting light. At 2000° F. the light emitted is such that the body is said to be at a bright red. At 4000° F. the amount of light will have increased far more than twice, probably as much as four times that emitted at 2000° F. It is reasonable to suppose that with a further increase of temperature the same ratio of increase will be observed, the proportionate increase in luminous intensity far exceeding the increase in temperature.

It would therefore appear that the employment of a resistance of platinum or other similar substance, whose temperature of alteration of state as compared with that of carbon is low, must be far less economical than the employment of the arc itself, which as now produced has been estimated as about two or three times less expensive than gas.

Indeed it would seem that future improvements in obtaining light from electrical currents will rather be by the use of a sufficient resistance in the most limited space practicable, thereby obtaining in such space the highest possible temperature.

Perhaps the highest estimate that can be given of the efficiency of dynamo-electric machines as ordinarily used, is not over 50 per cent. Our measurements have not given more than 38 per cent. Future improvements may increase this proportion. Since the efficiency of an ordinary steam engine and boiler in utilising the heat of the fuel is probably over estimated at 20 per cent., the apparent maximum percentage of heat that could be recovered from the current developed in a dynamo-electric machine, would be over estimated at 10 per cent. The economical heating of buildings by means of electricity may therefore be regarded as totally impracticable.

Attention has, long ago, been directed to the use of dynamo-electric machines for the conveyance of power. Their employment for this purpose would indeed seem to be quite promising. Since in this case one machine is employed to produce electrical currents, to be reconverted into mechanical force by another machine, the question of economy rests in the perfection of the machines and in their relative resistances.

In respect to the relations that should exist between the external and internal work of dynamo-electric machines, it will be found that the greatest efficiency will, of course, exist where the external work is much greater than the internal work, and this will be proportionately greater as the external resistance is greater. Our measurements gave in one instance the relation of ·82 ohm. of the arc to ·49 ohm. of the machine, a condition which indicates economy in working. The other extreme was found in an instance where the resistance of the arc was 1·98 ohms., while that of the machine was 4·60 ohms. a condition indicating wastefulness of power.

D'ARLINCOURT'S AUTOGRAPHIC TELEGRAPH.

IN the number of the Journal for Dec. 15th we gave some illustrations of results obtained by means of this ingenious form of telegraph instrument. We now give some details of the arrangements by which the apparatus is worked.

The general principle of the system is similar to that of the copying telegraph of Bakewell. The principle of this latter instrument is as follows :—

The apparatus at the transmitting and receiving stations are similar; at each there is a metallic drum, which is caused to rotate at a uniform rate of speed by clockwork mechanism. A toothed wheel fixed to one end of the cylinder gears into a pinion fixed on an axis which runs parallel with the axis of the cylinder, and which has a fine screw thread cut on it from end to end; a nut works on this screw, and has attached to it an arm with a metal style at the end, which presses against the surface of the drum. It is evident that the continuous rotation of the drum will cause the style to be carried along parallel to the axis of the former, and consequently to trace a continuous spiral line on the surface of the drum. Similar forms of apparatus being at the two stations, the drums are connected to the ends of the line wire, the style at the transmitting station being connected to the

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positive pole of a battery, whose other pole is to earth; and at the receiving station the style is connected to earth.

At the sending station, the message or design to be transmitted is written on tin foil with an insulating ink, and wrapped round the drum, whilst at the receiving station a sheet of paper wetted with a chemical solution, as in the Bain apparatus, is placed on the drum. As the two drums are caused by mechanism to rotate synchronously, and as the styles at any period of the revolution must therefore have the same relative positions on the tin foil and chemically prepared paper, and further since the current will only flow and decompose the solution during the time the style touches the tin foil, it is evident that the successive makes and breaks of the current will cause successive decompositions of the solution on the prepared paper, and thereby produce, by a succession of broken lines, a facsimile of the design or writing traced on the tin foil, the design appearing in white, and the ground in a colour corresponding to the nature of the chemical solution used. This, if the latter be ferrocyanide of potassium, the ground work will be of a blue colour. The success of the arrangement obviously depends upon the absolute synchronism of the revolution of the two drums, and this, in the apparatus subsequently invented by Caselli, was attained by means of electric pendulums; the arrangement, although successful, being somewhat complicated. A point of novelty in the latter system consisted in causing the style, whilst pressing on the portions of the metallic paper, to short circuit the battery, so that a current only flowed to line when the style passed over the insulating ink. This caused the facsimile on the chemically prepared paper to appear in colour, whilst the ground remained white. Instead of using the rotating drum, the style was caused to traverse backwards and forwards over the surface of the paper.

M. D'Arlincourt in his system employs the rotating drums and traversing style of the Bakewell instrument, and the battery short circuiting method, adopted in the Caselli instrument, but his mechanism for synchronizing the revolution of the two drums is a noticeable point in the invention. Fig. 1 shows generally the principle of the apparatus. *a*, *a'*, are drums provided with styles *s*, *s'*, as in the Bakewell apparatus. Ebonite pieces, *b*, *b'*, flush with the surface and running the full length of the drums, are fixed to the latter, so that when the styles rest on them the latter are insulated. *m*, *m'*, are electro-magnets, which have their armatures normally attracted by means of permanent magnets attached to their cores, as in the Hughes' type printer. The arms of these electro-magnets, when normally attracted, arrest the rotation of the drums when the latter are in the position shewn in the figure. *c*, *c'*, are cams fixed to the axes of the drums, and which have each a projection and a depression, the former of which raise the levers 2, 2', to the positions indicated in the figure, and which cause them to be in contact with studs 1, 1'. The depressions in the cams when the drums commence to rotate, allow the levers to change to the positions where they make contact with the studs 3, 3'. Finally when the drums rotate further, so that the levers press against the continuous surfaces of the cams, their position will be such that they make contact with the studs 2, 2'. *f*, *f'* are levers actuated by the same clockwork which rotates the drums, and which replace the levers *n*, *n'*, on to the cores of the magnets *m*, *m'*, after the drum has fairly commenced to rotate, when released by a current sent through *m* or *m'* as the case may be.

The clockworks which rotate the drums are so arranged that one drum can be caused to rotate at a rate one tenth less than the other. This is accomplished by the device shown in fig. 2.

a, *b*, are two crown wheels, which can slide along, but be rotated by the axle *f f*, which axle is geared indirectly to the drum on which the style presses. *c*, *d*, are two wheels on the axis *g*, which is connected to the speed regulator, which latter can only rotate at a certain definite velocity. In the position shown in the fig., wheels *a* and *d* gear together, but if the crown wheels are shifted to the left, the wheel *b* gears with wheel *c*. Since the relative sizes of the wheels are such that when *a* gears with *d*, the rate of revolution of *f* with *g*, is one-tenth less than it is when *b* gears with *c*, and since *g* at both stations can only rotate at one definite speed, therefore if at one station *a* gears with *d*, and at the other, *b* gears with *c*, then one drum will rotate with a velocity one-tenth less than the other. A small wheel *w* is attached to a spring fixed to the tubular axis on which *a* and *b* are mounted, for the purpose of keeping the wheels firmly in either position to which they may be shifted.

The working of the apparatus may now be made clear:—Supposing B to be the transmitting, and A the receiving station, then the metallic surfaced paper, on which the design or writing is traced, is put on drum *a'*, and the chemically prepared paper on drum *a*. The papers are so wrapped round the cylinder that they cover the whole surface, except the ebonite portions. The clockworks are so geared that *a'* rotates faster than *a*; also by means of a switch, 2' and 3', are connected together. The clockwork at A is now started by throwing *n* permanently out of gear, and drum *a* commences to rotate; as it does so, lever 2' drops from the projection into the depression in the cam and makes contact with 3, this causes a current to pass out to station B where it enters by lever 2', passing to 1', and through *m'* to earth; lever *n'* is thereby immediately released and rises up under the influence of a spring, thereby allowing drum *a'* to start off; immediately it does so, lever 2' drops down to 3' and then up to 2', where it remains during the remainder of the rotation of the drum; *l* in the meantime has risen to 2, so that even if *n* had been in gear the contact made by 2' with 3' would have produced no effect. The two levers being now at 2 and 2' respectively, the marking currents are duly transmitted between the drums. As *a'* rotates faster than *a*, before the lever 2' is again affected, *a'* will have completed its rotation and have been brought to a stop by *n'*, which, as has previously been explained, has been replaced by *f'*; and lever 2' will again have been brought to the position shown in the figure. Drum *a* then, when it has completed its rotation and continued it, again moves lever 2 to 3, again starts off *a'*, and so on; thus drum *a* rotates uniformly and continuously, whilst drum *a'* rotates also uniformly but a little faster than *a*, and is brought up sharp and started off again at each revolution. Practically then *a'* rotates synchronously with *a* and being checked at

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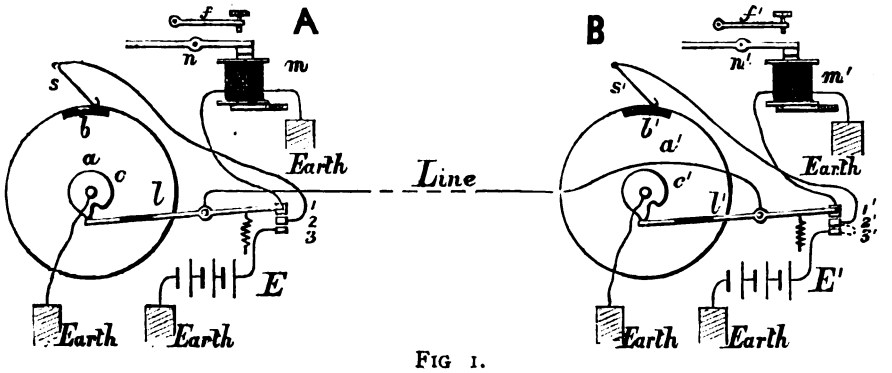

FIG 1.

each revolution can never be more than a tenth of a revolution out, and inasmuch as this one-tenth is distributed over the whole time of the revolution, no appreciable erratic effect is produced in the copy.

As it is very essential that the drum, which is checked at each revolution, should start off with its full velocity when the electro-magnet releases it, the clockwork by which it is turned gears friction tight with it, so that the train continues to run although the drum is stopped, and thus, when the

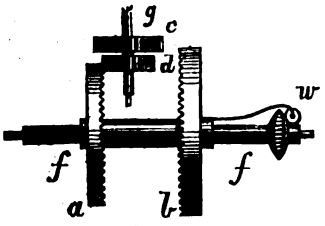

FIG. 2.

latter is released, it at once moves off with the same velocity at which the train is running. As the inertia of a drum, although light, tends to stop the motion of the train, a second train of clockwork quite independent of the first is connected rigidly to the drum, so that the latter is helped to start off quickly.

The motion of the clockwork train that moves continuously is controlled by means of a thick spiral spring governor, like that now employed on the Hughes apparatus. When working long distances a relay is employed, and there are means provided for neutralizing the effect of the static discharge which comes to be felt on long lines, and which would otherwise render the signals highly irregular and prolonged.

FLOOD TELL-TALE.—We learn from the *Moniteur Scientifique* that a new contrivance, invented by U. Camille Gras, for warning towns on the lower reaches of a river of the water level of its upper stream, has recently been tried with success between Laroque-Bouillac and Capdenac, on the river Lot. It consists of a float moored on the surface of the river, and an electric indicator, actuated by the float in such a manner that the needle follows the level of the stream. Indicators may be placed at distant towns, and connected to the float by telegraph. When the river reaches a certain flood level, an alarm bell is rung at these towns, and preparations may be taken against the coming flood.

LE BLANC'S FIRE TELL-TALE.—This ingenious fire alarm (for an account of which we are indebted to *Engineering*) is designed to indicate outbreaks of fire on premises. It is so constructed as to be sensitive to sudden rises of temperature, while it is unaffected by slow variations of the same. The sensitive part consists of two expansible plates of sheet zinc about 60 centimetres long and 0·05 centimetres thick, cut from the same piece so as to be isometric, or having an equal expansion. They are doubled into a gutter shape, so as to be more rigid, and are fixed at one end, while being free to expand at the other. One of these is swathed in flannel, and the other is bare to the atmosphere. When the variations of the temperature in the apartment where the tell-tale is placed are sluggish, the flannel round the covered plate will not interfere with its expansion; and both plates, naked and clothed, will expand equally. But when there is a sudden rise of temperature the bared plate will expand the faster. The effect of this is to make it bring a contact screw which it carries into contact with a spring contact carried by the plate, and the circuit being closed an alarm bell is rung.

ELECTRICITY IN CHINA.—On Tuesday, 1st Oct., we were entertained with a grand display of torpedoes at "Hsiku," near Tientsin, being the annual inspection of the students of the Imperial Torpedo College by H. E. Li Hung-chang. A straight reach of the main river was selected, about a mile in length, and all boat traffic stopped for the day. The students had been busy for two or three previous days laying down cables, joining up torpedoes, &c; and when H. E. arrived at the appointed time many thousands of spectators had assembled on the banks and house tops commanding a view of the situation. The work carried out was a representation on a minor scale of the defence of the channel at Taku. A chart was drawn out, showing the position of each torpedo, and they were fired in the order given by H. E., at the sounding of a bugle. As the last notes of the bugle died away the first charge exploded, throwing up an immense column of water in the air, to the height of three or four hundred feet; this was immediately followed by five other explosions, forming the outer line of defence. On the next word of command, seven torpedoes were simultaneously fired, throwing up a tremendous body of water and shaking the place as by an earthquake; these were followed by seven torpedoes fired singly; after which contact torpedoes were shown, in which heavy charges of powder were exploded, by a steam-launch striking the circuit-closer moored in mid-stream. The experiments were concluded by an array of five torpedo boats advancing in line, each armed with two fifty-pound spar torpedoes, which wheeling round a flag representing an imaginary enemy's ship, launched their torpedoes and fired at a given signal. The boats rose with the upheaving

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stream, and were instantly hidden from view by the large volume of water thrown up.

H. E. the Viceroy congratulated Mr. Betts warmly upon the success of the experiments; and calling up the students of the college awarded official rank to several of them and prizes to all, but as each one of the forty-nine torpedoes fired was the work of one individual student, it was difficult to draw a distinction where all were alike successful. H. E. returned to the Yamên at 6 p.m. Now that the inspection is over, the students will at once commence the erection of the Tientsin-Taku telegraph, and the survey for the Tientsin-Paouting-foo-Peking line will be carried out.—*North China Daily News.*, Oct. 9, 1878.

WE have to record the death of Sarah Faraday, widow of Michael Faraday.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

CLERAC'S RESISTANCE TUBE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—The *Times* for January 2nd contains a report of Professor Barrett's very interesting lecture upon Edison's inventions; but one phrase very much surprises me—viz., that relating to Clerac's variable resistance carbon tube, where Professor Barrett is reported to say that he can find "no trace of it."

Now, as Mr. Clerac entrusted to me in 1866 one of these tubes, which I have employed ever since, and publicly exhibited in all the Continental Telegraph Administrations which I have visited since that date, and as the existence of this tube can be testified to by thousands who have seen it for several years,—and even in London the officers of the Submarine Telegraph Company are ready to testify to my having made use of this tube at their offices in 1871-2,—and as I have the original one in my possession at the present moment, either the reporter of the *Times* has made an error or Professor Barrett has not had full possession of the facts. At the present moment there is a discussion taking place in the *Journal Telegraphique*, Berne, Switerland, in which Professor Zetzsche claims that the variable carbon rheostat was known and used by him before I showed Mr. Clerac's in Berlin in 1866. On this point I am awaiting proof. I believe, however, that prior to Clerac's tube, graphite or carbon was simply used as a solid resistance; whilst the essential part of Clerac's was the means he employed to compress it more or less in order to arrive approximately at the desired resistance. In fact, the only fault with it is that it is not a constant, and requires adjustment every few days if any exact degree is required; but it is exceedingly cheap, and for some purposes answers well enough.

The carbon rheostat brought out by Edison is an exact copy of that by Clerac. He no doubt thought it was original, simply because Clerac's tube was never heralded by any great praise or remarks in journals. Still that does not entitle him to ignore a fact publicly known; and after having been told of the existence of Clerac's tube it was the duty of Mr. Edison's agents to investigate Mr. Clerac's claims, either by reference to Mr. Clerac himself or to those, like myself, who could indicate where all information could be obtained.

I am sure that Professor Barrett wishes for no injustice, and would not ignore Mr. Clerac's claims if he thought them fully substantiated. Now, as I have the original tube in my possession here, and as I have much information I can easily give him or any one interested on the subject if he would kindly visit me at this house, I will show him all that relates to this subject.

94, Great Portland Street, W. D. E. HUGHES.
January 2, 1879.

THE SOURCE OF SOUND IN THE TELEPHONE.

SIR,—I write you to say that the experiments of Prof. Hughes, cited by M. Navez, have not led me to modify in any respect my views respecting the origin of sound in the Bell telephone, properly so called, that is to say *in a telephone without a battery*, and with a current whose force represents (after the recent experiments of M. Galileo Ferraris) that of a Daniell element after traversing a telegraph line, of which the length would be 290 times that of the terrestrial globe. I will never persuade myself that such a current is capable of exercising an effective attraction on a diaphragm of stiff iron. The experiments of MM. Duter and Govi [See TELEGRAPHIC JOURNAL, "Notes," December 15—ED.] have given me occasion to take up the question and to treat it from a higher point of view; and as soon as my researches are completed, I will lose no time in acquainting you with them. What astonishes me in the theoretic deductions of certain persons who have written upon the telephone is, that they have *lost sight of the fact that speech can be transmitted electrically in another manner than by electro-magnetism*, and it is evident to me, that the true theory of the telephone will be that which will embrace all cases of the electric transmission of speech. I have already thrown out some ideas on this point, in the second edition of my work on the telephone; but the more I study the question, the more I am led from the ideas held by M. Navez.

I beg you to receive, Sir, the assurance of my most distinguished sentiments,

Paris, *January*, 2. DU MONCEL.

AN IMPROVED SPEAKING MICROPHONE.

SIR,—In trying Professor Hughes' pencil transmitting microphone, I substituted for the sonorous upright board on which it is usually fixed, a disc of copper, seven and a-half inches in diameter, cut from a sheet that had been used in a Sir W. Thomson tray cell. The microphone was fixed to the side of the disc by means of an interposed piece of insulating wood. With the vibrating board I could get no articulation, but when the disc was substituted for it every word was easily heard in the telephone. The microphone was tried on about 400 yards of underground cable, with seven Minotti cells. I also tried, with the object of increasing the sound, a disc of iron seven and a-half inches in diameter, and about three times thicker than the above-mentioned copper disc, attaching also to the back of the plate the bowl of an electric bell. On lightly striking the bell a loud metallic ring came out on the telephone, with every wave beautifully defined, and, I may add, loud enough for a call signal. Through 100,000 ohms this metallic ring could be still faintly heard with the same battery power as above.

From these experiments I feel sure that the disc supports, whether of metal or wood, in fact anything connected with the microphone that is looked to for sound, should be in unison with the speaker's voice.

G. J. BURRIDGE.

Cable Bay, Nelson, New Zealand.

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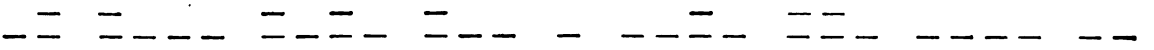
MR. HERRING'S INSTRUMENT.

SIR,—For the sake of your non-telegraphic readers, it appears to me very desirable that the recent article you devoted to Mr. Herring's device should not be allowed to pass without a remark or two, suggested as much by practical experience as by long consideration of the subject. At one time, indeed, I must have owned to a certain bias in favour of Mr. Herring, having myself met, under somewhat similar circumstances, with what I regarded as scant justice from the late engineer-in-chief of the Post Office; but increased knowledge has long since convinced me that the "eternal fitness of things," and not the Postal Telegraph authorities, is the real enemy with which Mr. Herring has to contend. One is truly at a loss whether to admire most that gentleman's "dogged resolution," or deplore his apparent lack of practical familiarity with current telegraphic requirements, whereby he remains, as it were, for ever whirling round and round in the back-water of invention.

Had he been content to apply his system to needles, Bright's bells, and similarly-worked instruments, the question would lie within very narrow limits; but when, in place of the universal Morse Alphabet and Varley's immortal "Double Current," he proposes to introduce his own peculiar "longs and shorts," worked by single current reversals, we may well enquire whether the proposed cure is not really worse than the alleged disease. Mr. Herring evidently believes that the horizontal dot and dash are apt to be mistaken one for another; but the fact is—as ninety-nine clerks out of a hundred would tell him—that "bad spacing," and not imperfect dots or dashes, cause most trouble and produce by far the largest number of mistakes.

A B C D E F G H I



I cannot digress to such an extent as would enable me to satisfactorily account for this failing, interesting as the point is, but simply enquire, will Mr. Herring's system be free from the same defect? Presuming the use of "tapper keys" for sending, I fear, the evil would be increased rather than diminished. For instance, look at the enclosed specimen "slip" taken in a somewhat similar manner as Mr. Herring's, except that the marks are horizontal, and are produced by two parallel printing discs one or both of which act as the left or right key is depressed at the sending station. This being my own device, and constantly joined up to a "Bell" circuit, *might* be always "turned on," but is not. Why? Because the attendant labour of even winding up the machine, let alone paper, tear and wear, &c., would not justify the possible gain of, perhaps, tracing by it two or three errors in a twelvemonth. The whole question is, clearly enough, one of expediency. The Postal Telegraphic authorities find they can get on very well without these recorders, and it is, therefore, a thankless thing to put in their way what they don't want.

The retention of visual systems will, to some slight extent (apart from automatic working) be unavoidable; but it is to the *ear* and not the eye that we now principally trust, and daily experience proves that our confidence is not misplaced. With sounders, receiving clerks are obviously obliged to "keep up" with the senders, and in the case of moderately sized offices, Postmasters or Superintendents are never at a loss to know what is going on, while as regards "calling," and liability to inattention, the voice of the sounder is not a thing to be ignored, its very importunity compelling attention.

With all respect, therefore, to Mr. Herring, I cannot help thinking how much greater service he can render to practical telegraphy by "rising upwards," working out "this printing delusion," and betaking himself, heart and soul, to the improvement of sounders. Then, and not till then, can he hope to earn the gratitude of operators or win the admiration of your humble servant,

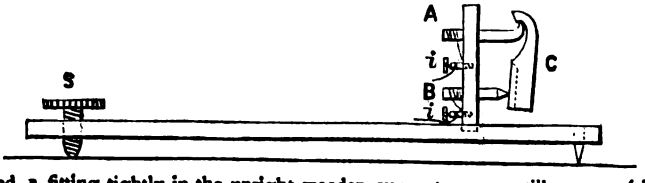
O.P.O., Christmas Day, 1878. M.

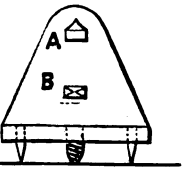
MODE OF REGULATING THE CONTACT PRESSURE IN A MICROPHONE.

SIR,—Assuming that sounds of varied intensity, and, perhaps those of different timbre, require a different degree of contact pressure in the microphone to produce a maximum effect, the advantages, in many cases, of a simple method for regulating this pressure at will, are evident.

I enclose a rough sketch of such an arrangement which I have found very efficient, it is at the same time simple, and affords delicate adjustment.

In the fig., A, B, and C, are as usual, pieces of gas carbon, *i*, *i*, are binding screws connected with the carbons A, B. In the end view, the carbon C has been removed.





The carbons A, B, can be adjusted to approximate position by sliding in their support, and then the third carbon being suspended, the fine adjustment is effected by the screw S, and may be facilitated by observing the point of contact against a white background.

Using a microphone of this description (with a Bell telephone receiver), by varying the contact pressure, one can hear distinctly the respective sounds of the tick of a watch, and the burr of the wheel work. Substituting for the carbon C an ordinary iron key (suspended "wrong way up,") the effect is still stronger (chiefly due to the greater stability of the contact below being thus less easily affected by air currents, &c).

A and B fitting tightly in the upright wooden support. A terminates, as shown, in a point which is lodged in a slight concavity in C, thus the latter is freely suspended above, while it makes contact beneath with B at *one* point, the intersection of two knife edges at right angles.

The microphone table is supported by three feet, two in front fixed, the third (S) behind consists of a small thumb screw, turning easily in the wood.

I have also made on the same principle a microphone with only two carbons, one fixed horizontally and pencil pointed, the other forming the bob of a short pendulum, suspended by a fine conducting wire, but owing to the stiffness of the wire, it is not quite so suitable.

Seraing, Belgium. R. LAWRENCE.

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Notes.

THE ELECTRIC LIGHT.—In our account of Jablochkoff's electric candle in our last issue we stated that Messrs. Wells & Co., Shoreditch, were the agents for the *Société Generale* in England. It appears that this is erroneous, and that Messrs. Wells & Co. are merely sub-contractors. The sole representative for this company in England is Mr. J. A. Berly, C.E., 139, Cannon Street, E.C.

EDISON'S ELECTRIC LIGHT.—According to Mr. Edison the cost for each electro-pyre, or electric burner of 20-candle power per year will be 1·95 dollars, as against 15 dollars for gas (in America).

APPLICATION for a third English patent for electric lighting has been lodged by Messrs. Brewer and Jensen on behalf of Mr. Edison. It appears to include a new dynamo-electric machine.

THE *Athenæum* reports that Mr. Edison has made arrangements for the production in England and America simultaneously of a book by him on the Electric Light. The English publishers will be Messrs. Sampson, Low, & Co., the American, Messrs. Harper, Brothers. The book will contain a full account of Edison's electric lighting system; and it is delayed for the present until the completion of the patents.

THE vital feature of Edison's plan for electric lighting consists in making each lamp in circuit absolutely independent of the variations of current in the circuit. Each lamp, by means of a regulator, the principle of which is not divulged, draws just sufficient current from the main to keep up a given intensity of light, whatever be the number of lights fed by the circuit. It may be conjectured that the regulator is based on the variable resistance of carbon under pressure, the pressure being produced by a heating or magnetic effect of the current.

LAST night he (Edison) made a discovery at four o'clock in the afternoon. He got a wire from Menlo Park to Plainfield, where his solicitor lives, and brought him into the telegraph office at that place. Mr. Edison wired him the discovery. He drew up the specifications on the spot, and about nine o'clock cabled an application for a patent to London. Before people were out of bed next morning, Mr. Edison received information that his application had been filed in the English Patent Office. The difference between London and New York time explains the matter.—*The Operator*, U.S.

WE hear that Mr. Edison has been over-working himself so much that chloroform had to be administered to make him sleep.

WERDERMANN'S ELECTRIC LIGHT.—*Apropos* of M. Reynier's claim of priority, Mr. Werdermann has explained to the Academy of Sciences, Paris, that his lamp is not based on the incandescence of carbon but on the formation of a very small arc or bead of light at the junction of the electro-pyres; the red-heating of the carbon being a concomitant not an aim of the system.

Touching this controversy, Dr. Cornelius Hertz writes to *L'Electricité* pointing out that Reynier's plan is a copy of Harrison's "rotating disc and pencil" method, patented in England in 1857.

WILDE'S ELECTRIC CANDLE.—The reason why the luminous arc in Wilde's electric candle locates itself at the extremity of the carbon rods, whether the candle be erect or inverted, is explained by Mr. J. Hopkinson in a letter to *Nature*. It is that the current in each carbon repels the arc in the same way as the current in the mercury trough repels the connecting cross-wire in a well-known experiment of Ampère. The inclined currents in arc and carbon are unlike in direction, and therefore repel each other.

WE hear that the Raffael Gallery in the South Kensington Museum is to be lit by Wilde's system.

THE WALLACE-FARMER ELECTRIC LIGHT has been fitted up, under the supervision of Dr. Sylvanus Thomson, in the tobacco factory of Messrs. W. D. and H. O. Wills, the well-known manufacturers of "Bristol Birds' Eye." The light is of special value in the "leaf" room where the tobaccos, when turned out of the hogsheads in their imported condition, are sorted with the greatest care, in order to get the finest and ripest leaves for the choicest brands of the firm. In this task the sorters are chiefly guided by the colour of the leaves, the tobacco of one growth in a single hogshead varying so much that every portion of it has to be assorted. For this delicate purpose the electric light is all that is required.

A COMPANY is being formed to work the Wallace-Farmer light.

THE ELECTRIC LIGHT FOR INDIA.—We have received from the India Office a précis of the report of Mr. Schwendler, the Government Superintendent Electrician, on the experiments conducted by him at the Indian Store Department, Belvedere Road, Lambeth, to test the suitability of the electric light for India. From these experiments Mr. Schwendler has come to the conclusion that there "is a considerable balance of evidence in favour of the introduction of the electric light into Indian railway stations." He therefore recommends a practical trial of it at the Allahabad or at Hourah Station. The machines tried were two Siemens-Altneck machines (size, medium and small) and two Gramme machines (one a workshop pattern supplied by Messrs. Soutter and Lemonnier, Paris, the other supplied by the British Telegraph Factory). Of these, Siemens' medium size has been found most efficient, and is with certain modifications recommended. The lamps tried were the Serrin and the Siemens, the former being preferred. We shall have occasion to refer to this report again.

ACCORDING to Prof. Anthony, of Cornell University, oil consumed in the steam engine will yield an electric light of three-fold power to the light which it will give on being burned.

MR. WHITELEY'S UNIVERSAL STORE is to be illuminated by the electric light; so also is the Langham Hotel, that famous haunt of travelling Americans. The British Electric Light Company are to undertake the latter work. The Crystal Palace is to be lit by the Sun Electric Lighting Company.

FARMING BY ELECTRIC LIGHT was successfully practised in France during last season. M. Albaret's arrangement is considered very well adapted to the purpose. It consists of a portable engine of four or five horse-power, carrying an iron mast from sixty to eighty feet high. This engine drives a Gramme magneto-electric machine, and the lamp which is hung from the top of the mast. The mast, which is com-

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posed of numerous iron tubes, can be raised or lowered at will by a winch at its base; and the lamp can be slung high or low by means of a rope and pulleys.

CHEMICAL EFFECTS OF THE ELECTRIC ARC.—At the meeting of the Chemical Society on December 13th ult., Mr. T. Wills read a paper on experiments which he had made to determine whether or not nitrogen gas was oxidised by the electric arc. The current from 60 Grove's cells was used for generating the light. The carbon points were placed under an inverted funnel, and the air supplied was aspirated through dilute potash to purify it. The nitrates formed were converted into ammonia with aluminium, &c. Nitric peutoxide, $N_2 O_5$, was formed at the rate of about 0·65 grammes per hour. Dr. Gladstone observed that the amount of nitric acid was very considerable; and Dr. Frankland expressed surprise at the result, for he had used the electric light for twenty years without observing any corosion of the brass or delicate clockwork of the lantern. The production of so much nitric acid under all circumstances with the electric light would be a serious drawback; but it could be overcome by enclosed lights of the Sawyer-Man type. Mr. Wills is to continue his experiments with currents derived from the Siemens' machine.

THE ALBO-CARBON LIGHT.—The Dundee Gas Commissioners have been investigating the question of the albo-carbon light, and they find that by the use of albo-carbon or napthaline, the illuminating power of the gas now supplied can be doubled, that is to say, 1,000 feet of gas supplemented by 1¼ lbs. of albo-carbon will give an illumination equivalent to 2,000 cubic feet of gas burnt in the ordinary way. The cost of albo-carbon per lb. is given on good authority as from 3d. to 4d. per lb. Taking it at 6d. per lb. the cost of gas in Dundee, burnt by the albo-carbon process is given as follows:—

1,000 feet ordinary gas	...	3s. 9d.
1¼ lb. Napthaline, at 6d. per lb.		0s. 10½d.
		4s. 7½d.

Thus an illumination by the albo-carbon process, costing only 4s. 7½d. would, by the ordinary plan (2,000 cubic feet at 3s. 9d.), cost 7s. 6d. It is probable, too, that by increasing the quantity of carbon consumed per 1,000 feet, a greater illuminating power could be obtained than is adopted in the above estimate.

THE TELEPHONE.—At a meeting of the American Academy of Arts and Sciences on Dec. 11th last, Prof. Graham Bell read a paper on the use of the telephone in tracing equi-potential lines and surfaces. He showed that for this purpose it was a better instrument than the galvanometer. He used a steel band telephone which could be clasped about the head, leaving the hands free to perform the experiments. By the use of metal exploring rods, the equi-potential lines could be traced in the ground under the observer's feet, or in the neighbourhood of metallic deposits, and in this way veins of ore, or peculiarities in the homogeneity of the earth might be discovered.

EDISON'S new telephone receiver is reported to render even a whisper audible to a person standing fifteen feet away.

CLERAC'S TUBE.—The controversy about the microphone and carbon telephone elicited the fact that M. Clerac, of the French Telegraph Administration, had discovered the property possessed by powdered carbon of varying its resistance under pressure as far back as 1865, when he applied it in the construction of variable resistance rheostats formed of tubes filled with powdered wood charcoal, coke, or graphite, which was compressed more or less to alter its electric resistance, by screws in the ends of the tubes. This property was re-discovered by Mr. Edison, and most ingeniously made use of in the invention of his carbon telephone. But there can be no doubt that Clerac observed the property in question long before Edison. In the most recent numbers of the *Journal Telegraphique*, Dr. Zetzsche has challenged Clerac's claims, alleging that carbon resistances were used prior to 1866 in Germany; but his remarks appear to apply to solid carbon resistances and not to variable ones of carbon dust. On this head we refer our readers to Prof. Hughes' letter published in our correspondence; and we may add that through the courtesy of Mr. Hughes we have seen the tube in question.

THE microphone is stated to have been at last successfully applied to auscultation of the heart by Surgeon-Major Wallich. According to the *Lancet* the water dropping from the esophagus into the stomach could be heard when it was applied to the stomach.

THE Raja Sir Madava Row, K.C.S.I., Dewan of Baroda, has pointed out two possible uses for the microphone peculiar to India. It appears that certain high Indian ladies would rather die of decline than allow the doctor to examine their lungs in the ordinary manner by stethescope; but with a microphone attachment they would no doubt submit to the process, the medical man being in this way kept at a distance. The other case consists in applying the microphone to the soil to detect the murmur of water flowing in underground strata, and thus indicating the places at which to bore wells. These spots are now selected by professional jugglers, who discover them by laying their ear to the ground in the silence of night.

THE PHONOGRAPH.—The phonograph appears to be degenerating, now that Mr. Edison has been forced to neglect his favourite offspring, and its articulation is getting worse and worse. We are sorry to hear that at a recent exhibition in a country town the well-known lines of Milton's L'Allegro—

> "But come thou Goddess fair and free,
> In heaven y-clep'd Euphrosyne."

were rendered by that incorrigible instrument as

> "But come thou Goddess fair and free,
> In heaven she crept, and froze her knee."

URGENT TELEGRAMS.—M. Linckens, of the Netherlands telegraph service, has been deputed to examine the results of the urgent telegram system, which has been tried there since last October. He finds that while over half of the Bourse telegrams are urgent hardly any come from private sources. M. Linckens is of opinion that the total number of urgent telegrams is not high enough to delay the ordinary traffic, and that these urgent telegrams render incontestable service to their senders.

GERMAN TELEGRAPHS.—According to the *Cologne Gazette* the Imperial German Government intend during the present year to push forward the works of the subterranean telegraph. It is proposed to lay the line between Cologne and Metz, which will cross the Moselle and the Sieg. The Bridges of Coblentz and other places will be utilised for this purpose, but a river cable will be laid across the Sieg at Siegburg. The subterranean cable will be constructed to correspond with

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those already existing between Berlin and Halle, and Berlin and Frankfort-on-the-Maine. The Reichstag will be asked to vote the necessary funds.

A NEW FRENCH ATLANTIC CABLE.—This project, which we announced in our last, is promoted by the *Société de depots et comptes courants*, the *Société financière*, and the *Credit industriel et commercial*, who have united to lay a Franco-American cable line from Paris to New York, which will be worked by a new company, the *Compagnie Française du telegraphe de Paris à New York*.

AT a pleasant conversazione, held in the Argyleshire Gathering Hall at Oban, on December 20th last, the telegraph was prominently represented by Mr. McLean, the postmaster of the town. A number of telegraphic appliances were shown at work by Mr. McLean; and the Highland folk had an opportunity of hearing the telephone. Judge of their delight when they found that it could speak "the gælic."

A TELEGRAPH line is being erected from Durban to Hangan, a place about twenty miles from the Zulu border, and near the coast.

WE learn from the *Journal Télégraphique* that on taking possession of the Dobrudscha the Roumanian government established eleven telegraph offices, forming a permanent service open to international correspondence. The Russians, however, would not permit them to open an office in Sulina.

THE French Government recently presented to the *Corps Législatif* a project for laying a cable between Australia and New Caledonia.

THE Eastern Telegraph Company, on the completion of their land lines in Cyprus, have suppressed the extra tax of 25 centimes for messages beyond Larnaca, the rate from Alexandria to Larnaca holding good for the whole island.

A NEW cable is to be laid between Manilla and Hong Kong, by the Spanish government.

M. BLAVIER has been nominated director of the Paris Superior Telegraph School, during 1879. M. Mercadier is professor of Physics, and M. Bontemps is professor of telegraphy.

MR. CH. BONTEMPS, chief of the pneumatic service of the French Telegraph Administration, has issued a work entitled *Les Systèmes Télégraphiques*, published by Dunod, Paris, price 8 francs.

THE TELEGRAPH IN THE YELLOWSTONE REGION, U.S.—The telegraph line from Deadwood to Fort Keogh, Montana, has been completed. This line opens Central Montana and the Yellowstone up to communication with the outside world, through the Black Hills and Cheyenne Telegraph line with which it connects.—*Journal of the Telegraph*, U.S.

TELEGRAPHY IN JAPAN.—Mr. E. Gilbert who for upwards of the past four years has had charge of the Government Telegraph Department as Superintendent-in-chief, but whose engagement is about to terminate, was entertained by the Acting Minister of Public Works, Yamao Yozo, at a banquet at Shiba Palace. Its Hirobumi, the Minister for the Home department, and about thirty other gentlemen were present. A very cordial and pleasant evening was spent, and all united in expressions of good will and good wishes for Mr. Gilbert's future happiness. We believe Mr. Gilbert has given the Government ample satisfaction from the way in which he has conducted the important department under his charge, and leaves the lines of telegraph in as excellent a condition as the best lines in any part of the world.—*Japan Daily Herald.*

JAPAN INSULATORS.—The *Japan Mail* is responsible for the statement that telegraphic insulators made at the village of Imari, in the province of Hizen, are so good that they find a large sale in Europe.

MUIRHEAD'S DUPLEX SYSTEM is to be applied next to the Porthcurnow and Vigo section of the Eastern Telegraph Company's system. Dr. Muirhead has proceeded to Vigo for that purpose.

FOREIGN ELECTRICAL WORKS.—The following are the most recent electrical publications:—*Laroboh i Telegrafi*, by C. A. Nyström (Stockholm: F. and J. Beijer, 1878); *Die Harmonie der Töne und des Lichts*, by A. N. Bohner (C. Rümpler, Hanover); *Weiter Zur Kenntniss der Coarcitivkraft des Magnèteisensteines und des Glasharten Stahles*, by A. L. Holz (Jena); *Ueber Theorie und Anwendung der Elektro-magnetischen Rotationem*, by M. Margules (Gerold, Vienna); *Die Telegraphentechnik der Praxis*, by A. Merling (Carl Meyer, Hanover); *Telegrafie Electrique*, by L. Honzeau (Paris); *Ueber den Vorlauf der Funkenwolke in der Ebene und in Raume*, by E. Mach (Gerold, Vienna); *La Elettricita e il Telegrafa*, by C. Pianta (Milan); *Die Magnet und Dynamoelektrischen Maschinen, ihre Entwickling Construktion und Praktische Anwendung*, by H. Schellen (Du Mont Schauberg, Cologne); *Nuovo Compendio di Telegrafia Elettrica*, by G. Tamburello-Santemgelo (Palermo); *Resumé des cours Elementaire de Telegraphie Electrique*, by H. Cailleret (Lille).

Reviews.

Instructions for Testing Telegraph Lines, and the Technical Arrangement of Offices. By LOUIS SCHWENDLER. Vol. I., Second Edition. London: Trübner & Co., Ludgate Hill. 1878.

THE introduction to this work states that the testing instructions were originally written for the special use of the staff of the Government Telegraph Department in India, in order to facilitate the introduction of a rational system of testing the lines, and the technical arrangement of telegraph offices. Since these instructions were drawn up, the author has made considerable additions in the shape of a number of pamphlets, and these he has now combined with the necessary alterations, into the volume which has just been published, and into a second, which will be published later on.

Mr. Schwendler, at the latter part of the introduction, states that he "has been surprised to find how little progress Testing has made. I was always told (he says) "Yes, we should like to introduce a general system of Testing; we know its practical utility; but show us a system to do it, and which will work satisfactorily." We must confess that we are equally surprised with the author, but

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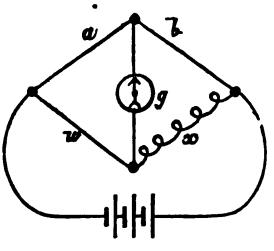
our reason for being so is, that this statement should have been made without qualification. Writing, as the author does, from the metropolis of the kingdom which possesses one of the most efficient telegraph systems in the world, we think it surprising that he should not have taken the trouble to enquire whether any system of Testing existed in the Postal Telegraph Service; if he had done so he would have found that a system did exist, and that this system although not so elaborate as that drawn up for use in the Indian Service, was as equally efficient.

As regards the other telegraph administrations, we very much doubt whether the systems advocated, although thoroughly efficient for the purpose for which they were drawn up, would be of much use to them, though no doubt very many useful hints might be taken from the work, and for that reason the latter is of practical utility.

In Part I., Section I., the Wheatstone bridge and, the differential galvanometer are chiefly treated of. The former is very fully described, both practically and theoretically, but we think that in treating of the sensibility of the method of testing by this invaluable system, Mr. Schwendler has worked on a false basis. The object of his analysis is to show what relative values the four arms of the bridge should have to one another in order that a test may be made with the greatest possible accuracy.



The conclusion Mr. Schwendler comes to is that for maximum sensibility, the four arms a, w, b, and x, should be equal; that is to say, if x be the unknown resistance, a rough measurement should be first made, so as to determine approximately its value, and then a and w should be made alike and as nearly equal to x as possible, and so that by adjusting b exactly, we get, $x=b$. Such an arrangement of the resistances is supposed to give maximum sensibility, because any small change in the value of b (supposing the latter to be the adjustable resistance) produces the greatest deflection on the galvanometer g. This we do not deny, although Mr. Schwendler's proof is by no means an easy or clear one to follow, but it is not true that this condition of maximum sensibility is the one for obtaining maximum *accuracy*.

It must be perfectly evident that with the sides a and w equal, if b is adjustable only to units, as is usually the case, no matter how sensitive the system may be, we cannot determine the value of x to a closer accuracy than 1 unit; if, however, we have a 10-times w, then every unit in b represents 1 unit in x, so that even supposing the sensitiveness of the galvanometer were only sufficient to enable an adjustment of 10 units in b to be made with accuracy, we should still be able to determine the value of x within 1 unit, since, as we have pointed out, 10 units in b represent 1 unit in x. But it may be objected, supposing balance to be obtained, that the alteration of 10 units in b, with a ten times as great as w, would not produce as great a deflection of the galvanometer needle as would 1 unit in b when a and w are equal; this may be so, but still that deflection may be sufficiently great to enable a closer adjustment than 10 units to be attained; in fact, as is well known, such is very frequently the case; with a Thomson galvanometer no one would think of having a and w equal, simply because that is the most sensitive arrangement. As long as any perceptible deflection can be perceived by an alteration of 1 unit in b, the greater a is made than b the more accurately can the value of x be determined.

Again, granting, as we said before, that the proof given is correct, Mr. Schwendler does not prove, what is really of much more importance, that the rigid rule laid down by him may be departed from to a very great degree without the sensitiveness of the system being materially reduced. In fact, it admits of proof that a may be made ten times as great as w, and yet the sensitiveness of the system be but very little diminished. Thus, if with a and w equal we obtained, by an alteration of 1 unit in b, a deflection from zero of 3°, then with a ten times w, an alteration of 10 units in b (which corresponds to 1 unit in x), would only reduce this deflection to about 2°.

We have entered into this question at some length for the reason that the common method of obtaining the conditions of maximum sensitiveness in any test by the differential calculus is misleading. The proper course to pursue is to put the equations representing the conditions for sensibility into such a form that an analysis can be made, and the limits of the conditions seen by mere inspection. It is by no means difficult to do this, and the insight which it gives into the questions will be found to be somewhat surprising to those who have not made the attempt.

Following the Wheatstone bridge, are descriptions of the differential galvanometer methods of testing, and the part concludes with a short description of battery measurements.

In most cases numerical examples are given, which render the comprehension of the tests more clear than would otherwise be the case.

Part II. commences with a dissertation on natural currents such as are due to prolongation of earth plates, atmospheric electricity, &c. In Section I., Part II., regular testing is dealt with. Under this heading we notice some elaborate formulæ, the following for instance :—

$$L = \frac{1\,(k+1) + w\,(k-1) - \sqrt{\left[\left\{(1-w)(k-1)\right\}^2 + 4\,k\,l\,(1-w)\right]}}{2\,k^2}$$

with reference to which Mr. Schwendler says, "But as k is *not* known in those cases in which we require to use these general formulæ, the equations must be put into another form." This being the case, the advantage of filling up the work with such matter is not evident.

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But although the book is full of formulæ, and many of an elaborate character, a large number of the latter are of practical utility, but at the same time are only requisite where the testing sections are extremely long, as is very often the case in India, and where an accurate test may mean the saving of a journey of 100 miles or more.

At the end of Section I., illustrations of the record of tests sheets are given, judging from which, and from the instructions and formulæ necessary for making the calculations, the testing clerk must have his time very fully employed each day.

Section II. deals with fault testing, and in this, every kind of fault is dealt with; but the formulæ to be employed in each particular case are so mixed up with explanations and developments as to cause great confusion. In fact, the book throughout cannot be called thoroughly practical. It contains useful practical matter, but this is so entwined with the explanations that it is difficult to lay your fingers on any particular test that may be required. It is a pity that the theoretical is not kept more separate from the practical matter—the book would be greatly improved if it was.

New Patents.

5250. "Thermo-electric generators." W. SCOTT. Dated December 23.

5255. "Improvements in the composition and manufacture of phosphorescent powders, and in a special mechanism for augmenting the intensity and duration of their luminous properties (by applying electricity). W. MORGAN-BROWN. (Communicated by J. Peiffer, W. F. MacCarty, and Prince T. P. de Lagan.) Dated December 24.

5257. "Induction apparatus." J. H. JOHNSTON. (Communicated by A. de Méritens.) Dated Dec. 24.

5270. "Underground telegraphs." F. R. LUCAS. Dated December 24.

5281. "Construction of electric lamps." A. M. THOMPSON, H. D. Earl. Dated December 27.

5292. "Telegraph apparatus." S. PITT (communicated by E. B. Welch). Dated December 27.

5306. "Improvements in means for developing magnetism and electric currents and in apparatus for illuminating by electricity." T. A. EDISON. Dated December 28.

5307. "Carbons employed in the production of the electric light." J. B. FREEMAN. Dated Dec. 28.

5313. "Telegraphic recording apparatus." R. K. BOYLE. Dated December 30.

5321. "Underground telegraph lines." J. S. PIERSON. Dated December 30.

ABSTRACTS OF PUBLISHED SPECIFICATIONS

1326. "Interlocking apparatus for the points, &c., of railways." C. HODGSON. Dated June 13, 1878. 8d. This describes a means whereby the interlocking gear can be used in connection with telegraph instruments working with one line wire, without interfering with the ordinary use of these instruments on the wire.

1370. "Telephones." A. PARIS, Hamburg. (C. HODGSON.) Dated April 6, 1878. 6d. This consists in a plan for putting the telephones in circuit with the line for speaking, by simply lifting them from hoppers or receivers where they rest when not in use. When on the hoppers the line is in connection with the signal bell or alarm used in connection with the telephones.

1375. "Signalling on railways." T. T. POWELL. Dated April 6, 1878. 6d. This consists in means of communication between different parts of a train, and in a mode of acquainting the signalman of the position of a train on his block.

1419. "Transmitting messages." M. T. NEALE. Dated April 9, 1878. 6d. This consists of a pneumatic despatch for private use. Small carriers containing the written messages are sent along tubes on compressing the air behind them by means of a piston.

1467. "Originating and developing electric currents." H. C. SPALDING. Dated April 12, 1878. 2d. A series of dynamo-electric machines are to be employed together, so that a feeble current generated in the first shall, on passing through the rest successively, be greatly intensified. *Not proceeded with.*

1519. "Apparatus for raising ships, anchors, and telegraph cables, &c." H. SCHALLEN. Dated April 16, 1878. 8d. The grapnels described therein as specially adapted for cable lifting consist, firstly, of a shank having a curved prong, in the cusp of which is a carved shamrock-leaf recess, into which the cable falls and is retained, and secondly, of a shank with serrated clip prongs, that is, jaws which close on the cable like pincers when it is hooked and being hauled up.

1522. "Galvanic batteries." PETER GRABINGER, Athens. Dated April 16, 1878. 2d. This describes the well-known Leclanché element. *Not proceeded with.*

1564. "Apparatus for igniting and extinguishing gas by electricity." J. W. BARTLETT, New York. Dated April 18, 1878. 4d. An electro-magnetic apparatus whereby a spark is caused to pass through the gas on breaking the circuit. *Not proceeded with.*

1613. "Telegraphy." J. B. MANGENOT, Paris. Dated April 22, 1878. 6d. This consists in a field telegraph, the currents being generated by a magneto-electric rotary machine. The receiver consists of two terminals side by side but insulated from each other, and connected to earth and line respectively. When pressed on the finger, cheek, or tongue (according to the strength of the received currents) a slight shock will be felt at each signal.

1644. "Recording and reproducing sounds. T. A. EDISON. Dated April 24, 1878. 10d. This describes Edison's phonograph, and the various kinds of "phonograms" or sound-records obtained, as well as the "phonets," or apparatus for reproducing the sounds from the phonograms, which may be used.

Proceedings of Societies.

PHYSICAL SOCIETY.

AT the meeting on December 14, Prof. W. G. ADAMS, President, in the Chair.

Prof. GUTHRIE read a note by Mr. C. Boys on a Condenser of Variable Capacity. This condenser was designed for use in connection with the Holtz machine to shew the effect of condensation on the length of the

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spark. It consists of a test-tube coated externally with tinfoil to form the inner armature, and a glass tube enclosing the test-tube, and having its outer surface covered with tinfoil for the outer armature. The inner tube can be slid out or in along the length of the external tube, and the capacity thereby varied. Prof. Guthrie showed that a spark from the Holtz machine could by its means be gradually reduced. Prof. McDonnel states that he had for some years used a similar apparatus, the inner coating, however, being strong sulphurous acid.

DR. O. J. LODGE exhibited a Differential Thermometer, in which saturated water vapour took the place of air or other gas; and based on the fact that the pressure of saturated vapour, in contact with its liquid, depends only on the temperature. An ordinary cryophorus held nearly horizontal, answers very well; any difference of temperature between the bulbs causing a difference of level between the liquid in the stem and that in the adjacent bulb. The instrument is, however, only correct for low temperatures; but will serve as a delicate thermoscope for class purposes.

MR. W. CLARK gave the surface tension of liquid sulphurous anhydride as derived from its capillarity as 2·3 milligrammes per square millimetre at — 15° C.

City Notes.

Old Broad Street, Jan. 13th, 1879.

IN our last issue we mentioned that the Franco-American Cable Scheme was about to be brought forward. A Maclean's telegram of the 10th inst. from Paris states that the aforesaid company, formed to carry out M. Pouyer-Quertier's Concessions, has been constituted, and the prospectus has been issued. The capital is 52 millions of francs, with a first issue of 42 millions in 84,000 shares. It is proposed to lay two cables, viz., from Brest to Cape Cod, and from Land's End to Nova Scotia, both *via* Saint Pierre.

On the 4th inst., we were informed by the Secretary of the Direct U. S. Cable Company that a defect had appeared in the cable of that company near the shore at Torbay, delaying the transmission of messages, which, until the fault is removed, will be forwarded by the Anglo route.

The Eastern Extension Telegraph Company notified on the 9th inst., the repair of their Singapore Batavia Cable, thus restoring direct telegraphic communication with Java, Australia, and New Zealand.

A dividend has been declared by the Great Northern Telegraph Company for the past half year at the rate of 5 per cent. per annum on its share capital of £1,500,000.

The Stock Exchange Committee have ordered the reduced capital of the India-Rubber, Gutta-Percha and Cable Work's Company to be quoted officially, and to be marked ex-West Coast Shares.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 58¾-59¼; Ditto, Preferred, 83½-84½; Ditto, Deferred, 33-34⅛; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅛-6⅜; Cuba, Limited, 8¼-8¾; Cuba, Limited, 10 per cent. Preference, 15¼-15⅝; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 9⅜-10¼; Direct United States Cable, Limited, 1877, 11⅛-11⅜; Eastern, Limited, 7¼-7½; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1887, 101-104; Eastern, 6 per cent. Preference, 11⅛-11⅜; Eastern Extension, Australasian and China Limited, 7-7¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; German Union Telegraph and Trust, 8-8½; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 10¼-10½; Great Northern, 7⅛-7⅜; Indo-European, Limited, 19-20; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 8½-9½; Reuter's, Limited, 9½-10½; Submarine, 217-222; Submarine Scrip, 1⅞-2⅛; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 8-8½; Ditto, ditto, Second Preference, 7½-8; Western and Brazilian, Limited, 2¼-2⅜; Ditto, 6 per cent. Debentures "A," 87-92, Ditto, ditto, ditto, "B," 84-88; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 29-30; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2⅜-2½; India Rubber Co., 8¾-9¼.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £3,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,102,420.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£ δ	£	£	£ δ	£
December, 1878	47,040	14,231	2,800	940	13,970	38,467	22,929	14,803	... ...	8,498	... ...	... ...	5,304
December, 1877 ...	45,570	12,318	2,666	858	12,930	37,777	23,980	15,511	... ...	8,754	... ...	... ...	4,558
Increase	1,470	1,913	134	82	10,40	690	... ...	... ...	... ...	... ...	... ...	... ...	746
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	1,051	708	... ...	256	... ...	... ...	... ...

δ Not published.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 144.

THE SOCIETY OF TELEGRAPH ENGINEERS.

ON the evening of January 22, Dr. C. W. Siemens, the retiring President, resigned the Chair of our Society to Major Bateman-Champain, R.E., who delivered his Inaugural Address. Dr. Siemens was the careful nurse of the Society while yet in its infancy, he sheltered it by his great name and fostered it by his labour, and we feel sure that its members will regret to be deprived, even temporarily, of the presence of (to apply a phrase which, in these ungenial times, has even dropped out of H. M. Letters Patent) their "trusty and well-beloved" first and latest Chairman.

The present year will be an unusual one for the Society of Telegraph Engineers. Upon it will devolve the duty of welcoming and entertaining the foreign delegates, who will sit at the first International Telegraph Congress which has ever been held in London. Major Bateman-Champain is a gentleman who has already had much experience of these Congresses, he is acquainted with many of the foreign delegates who will attend the forthcoming one, and in selecting him for their President during the ensuing Session, the Society of Telegraph Engineers have, we believe, put the right man in the right place.

The Inaugural Address of Major Bateman-Champain, which we publish in this number, will be found to contain a complete and lucid account of all previous International Telegraph Congresses, and it will be read with gratified interest in all parts of the world, not only by professional electricians, but by those not technically interested in telegraphy. It would be premature, as yet, to deal with the question of international tariffs; and we will, therefore, turn to the remarks in the address upon the prosperity of the Society itself. It is satisfactory to learn that the Society now numbers in its ranks more than a thousand members, associates, and students, and that by means of the loan generously offered by a few members, it is now "well established on a firm footing," to use Major Bateman-Champain's own words. Such are the rapid developments of electrical science now going on, that it requires no gift of prophesy to foresee a flourishing future for our Society, and we are glad to hear that, despite the straitened circumstances of the last year or two, it will enter upon 1879 with an unclouded prospect.

It appears to us, however, and we are sure we speak what is in the minds of many of its unofficial members, that there is an important flaw in the state of the Society at present, and that the Society will never be centrally strong and thoroughly alive until it is remedied. We refer to the morbid and lifeless condition of the Society's rooms. The reading-room and library of the Society, its local habitation to hundreds of its members abroad, and what should be the seat of its circulation to members at home, is practically shut. A noble library fills its shelves with literary treasures, which the visitor may admire, but is requested not to touch; its cupboards overflow with electrical periodicals, which, it may be presumed, were ordered for its reading-table, and the hardy member who dares to enter its forbidden precincts, experiences some of the uneasy emotions of an interloper. The Society of Telegraph Engineers reminds us herein of one of those antique yew trees which the adventurous traveller sometimes descries in remote rural graveyards, far from the busy haunts of men. All green and darkly beautiful to outward view, it seems to him the very embodiment of staunch (though somewhat lugubrious) life; and it is only when he comes to look inside that he discovers, and discovering mourns, the emptiness within. If the traveller be a Londoner, he will probably not be disposed to take exception to the yew tree for conforming to the first canon of Cockney morality, by keeping up a good appearance; but, if he be not likewise a fool, he will admit that it is of far more vital importance to the tree to have a sound core. We would have the rooms of the Society of Telegraph Engineers what they ought to be, a reading-room for students of electric science, a reference library for professors, and a resort for foreign members when they come to London.

In order to promote this healthy state of being, the first thing to be done is to put the library in order and open it to readers. The publication of the Ronalds' Catalogue has, we know, been a severe strain on the resources of the Society, and when finished it will, undoubtedly, be a credit to the latter; but from the way in which it has been talked about, while the books themselves have been neglected, one would think that the library merely existed in order to furnish the catalogue. The shadow has been mistaken for the substance before, and it may even be advisable for us in this case to hint that libraries are even more important than catalogues. The books of the Ronalds' Library are, we believe, to be indicated by an asterisk in the Ronalds' Catalogue, and the catalogue could be published at once if the money were in hand. But ought the library, we ask, to remain a sealed book because the

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larger catalogue, of which it forms but a part, cannot be published? Certainly not. A small catalogue for the Ronalds' Library alone could be printed very cheaply for the use of members, (many of whom would purchase it who would not purchase the Ronalds' Catalogue), and the library opened for reading. Nor is even this plan necessary in order that the library may be accessible, for if a manuscript catalogue were made out and deposited in the library for reference, the works which Sir Francis Ronalds collected with love and care, might be put to some use. As supplementary to the library, the reading table ought to be kept regularly supplied with all the home and foreign electrical periodicals. A few of these are now taken in at the rooms, and, perhaps with a view of preserving their virtues unimpaired for future generations, they are speedily bundled up and stowed away. But more of these periodicals should be taken in, and they should be allowed to remain in a cut condition on the table until replaced by the next numbers.

Hitherto the Society of Telegraph Engineers has been unfortunate in not having a permanent secretary. Prior to Mr. Langdon's appointment, the secretarial work fell into arrear, and it is only due to the latter gentleman to say that, in the short term of his office, he recovered nearly all the ground that his predecessors had lost. The Society is now, however, well and fully officered, and we hope that the defects which we have indicated will soon be remedied.

We are glad to see that, thanks to the recently-appointed "Chairman of the Editing Committee," the Society's journal will be issued more frequently than before, so that a particular paper read will be in the hands of members very shortly afterwards. This step is likely to promote the welfare of the Society, and as a certain extent of scientific publicity beyond the strict bounds of the Society itself is well-known to have a similar effect, we think that the Society might do well to follow the example of other learned societies, such as the Royal Society, the Physical, the Meteorological, and the Institution of Civil Engineers, and furnish abstracts to a few of the scientific periodicals. The preparation of these abstracts would entail a little extra labour on the "Chairman of the Editing Committee," but we feel sure that this work would be a very trifling tax on the luxuriant abilities of Professor Ayrton.

With the extra task of entertaining the International Telegraph Congress upon his shoulders this year, it may be too much to ask Major Bateman-Champain to see to these internal improvements; but we can assure him that if he has time to get them carried out, he will earn the thanks of the general body of the Society.

INTERNATIONAL TELEGRAPH CONGRESSES.

The Presidential Address to the Society of Telegraph Engineers by MAJOR J. U. BATEMAN-CHAMPAIN, R.E.

AFTER alluding to the prosperity of the Society and reviewing the progress of electrical science during the past year, Major Bateman-Champain continued as follows:

Now, gentlemen, although the improvement and perfection of the apparatus and machinery in use for the transmission of messages are undoubtedly objects of the first importance to us, yet I am of opinion that, as "telegraph engineers," we may with advantage direct attention now and then to the means by which that machinery is employed and controlled.

I propose, therefore, this evening to make a few observations on the practical administration of the telegraph system, on the efficiency of which the utility of one of the most marvellous of all modern inventions very largely depends.

I am aware that the subject may be considered somewhat commonplace by many here assembled, but I must humbly own that I am fully conscious of my inability to guide you among the higher mountain paths familiar to my distinguished predecessors,—I must plod in the valley or stay at home,—and I am sensible that I owe you some explanation of the reason which led me to acccept the unmerited honour which has been conferred on me, and to adress you as your president this evening.

It is simply this. This summer will, we hope, witness the assembly in London of one of those international telegraph conferences which are held from time to time to revise, and, where necessary, to modify, the legislation accepted by the adhering States. It has been my duty to attend one or two of such conferences, and, consequently, I have gained some knowledge of the several steps which have led to the adoption of the laws now in force. I may add that it is my good fortune to be on intimate and friendly terms with many of the foreign delegates whom we hope to welcome in London, and I flatter myself that I might, as your president this session, be able to render some small service to the Society. It struck me, too, that an explanation of the past history and efforts of these conferences might not be inopportune at the opening of the year 1879.

In the early stages of the development of the electric telegraph, when the wires were gradually creeping from city to city, and when the telegraphs of each country were, so to speak, self-contained, each administration made its own rules and cared nothing for its neighbour. It was not until nearly the middle of this century that the lines of one country began to cross the frontiers and to hook on to those of the adjoining States, and international telegraphy became an established fact.

The necessity of well-defined laws for the regulation of the international traffic was immediately felt, and from comparatively small beginnings, to which I shall devote a few words, the present complete and elaborate code has been drawn up, and is now accepted over nearly the whole civilised world. The International Convention does not, of course, lay down laws for the internal traffic of the several States; one country may choose to tax its local messages by the word or even letter; a neighbouring country may, if it pleases, tax on the 20-word system and give the address free; but international messages, that is to say, messages crossing the frontiers, are all taxed and generally treated in strict accordance with Convention laws. Just as in railway administrations, one State may select for its

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internal traffic a broad gauge, another a narrow, and a third the metre gauge; but directly an international system of railways comes into play, the States interested must obviously agree among themselves on a uniform standard and on uniform working rules. Nowadays, international conferences to legislate on railway, postal, eletric, and other subjects are frequent, but telegraphy was the first to be so treated, and since the date of the earliest meeting in Paris, 26 years ago, periodical assemblies have been held with considerable regularity.

Like almost everything else, these conferences had small beginnings. The original one was attended by representatives of the following Governments only: Belgium, France, Prussia, Austria, Bavaria, Saxony, Hanover, Wurtemburg, and Holland. State after State then began by degrees to join, until at the last meeting at St. Petersburg all the nations of Europe, besides three or four extra European countries, were parties to the International Telegraph Convention. From 1852 to 1858 these conferences were, comparatively speaking, rather numerous; partly because different arrangements were entered into between different groups of administrations, and partly because in those early stages of telegraph administration want of experience necessitated frequent revision and remodelling.

The dates of the eleven chief conferences which have been held are as follows:—

Paris	4th October, 1852.
Berlin	29th June, 1855.
Paris	29th December, 1855.
Brussels	30th June, 1858.
Berne	September, 1858.
Friedrichshafen ...	26th October, 1858.
Paris	18th May, 1865.
Vienna	21st July, 1868.
Berne (supplementary),	2nd October, 1871.
Rome	14th January, 1872.
St. Petersburg	...7-19th July, 1875.

The rule at present is to meet once in about three years; a conference, therefore, would in due course have assembled last year, as anticipated in the opening address of our late president; but from the disturbed condition of Europe and other causes it was postponed until the summer of 1879.

At the earlier conferences each State was represented by a diplomatic official of rank, but latterly the delegates have usually been officers of high standing in the telegraph administrations of the several countries, and these delegates have powers to agree to the generally-approved alterations, subject to eventual ratification by their respective governments. India accepted in a general way the Convention rules almost immediately after the completion, in 1864, of the Indo-European line of telegraph, which connected the Indian system with that of Europe, and she joined formally at Vienna in 1868, when Colonels Goldsmid and Glover were India's delegates at the conference. I may observe that, although it has been the custom for each State to send more than one representative official, a single vote only is granted to each distinct government.

In 1868 the telegraphs of this country were not, as now, worked by the Post Office, and, consequently, Great Britain was not represented at the Vienna Conference. The first cable between this country and the Continent was laid, I may remind you, in 1851, and the British companies soon found themselves obliged to treat their foreign traffic in accordance with the international regulations. England joined the Convention after the purchase of the inland wires from the companies, and Messrs. Chambré and Fischer, of the Post Office Telegraphs, were for the first time deputed to represent this country at the Rome Conference of 1872.

One vote was given to Great Britain and a separate one to India, in consequence of the independent character of the administrations of the two Governments and the different interests they might have in view.

It will be obviously impossible for me, within the limits assigned to a presidential address, to describe to you fully the legislation affecting international traffic and tariffs established at the different conferences; but by confining my attempts to a brief outline of the original Convention of Paris, with a sketch of two or three of the principal modifications subsequently introduced into it, and the chief provision since made to keep pace with the requirements of the times, I hope to furnish you with some materials for forming an opinion on the value of the labour expended in this particular branch of our profession. And here I would draw your attention to what appears a rather remarkable fact, that although upwards of a quarter of a century has elapsed since the first Convention was drawn up between the representatives of a few States at Paris, its enactments, so far as they go, have virtually formed the groundwork of all our subsequent legislation: a circumstance which bears emphatic testimony to the care and completeness with which they were thought out and prepared.

The main provisions of the original Convention, signed at Paris in 1852, were the recognition of the right of all persons to use the international lines on prepayment of their messages; the stipulations that messages from the public should be written in an intelligible manner; that the languages employed should be French, German, or English; and that senders should furnish proof of identity when required, and that Government messages only might be sent in cipher. The contracting states engaged that a sufficient number of wires should be set apart for international traffic; that the best instruments should be made use of; that secresy should be maintained; and that the charge for any message lost, mutilated, or seriously delayed, should be refunded. This was the limit of administrative responsibility, which has not been since extended. It was arranged that all messages should be classified and transmitted in the following order:

1. Government messages;
2. Service messages between telegraph administrations;
3. Messages from the public;

that the telegrams of each category should be signalled in the order of their deposit by the senders, or of their arrival at the intermediate stations; and that the signalling of any message once commenced should not be interrupted to give place to a despatch of superior rank, except in cases of absolute emergency. It was provided that messages stopped in consequence of interruptions of the lines should be forwarded by post; that all international offices should be open during specified hours; and that any sender should be at liberty to prepay a reply or an acknowledgment of receipt, or to have his message repeated *en route*, to ensure greater accuracy. The Governments accorded the power to other States to accede to the Convention on demand; and each reserved to itself the right to suspend the service on its lines, either altogether or for certain classes of messages, on condition of giving immediate notice to the other contracting Governments.

The unit of charge was for a standard message of 20 words, with double rates at night; and each contracting State was divided into a number of zones, with a separate charge for each zone, according to its distance from the frontier.

Considerable modifications have since been made in the length of the standard message and in the tariffs for each country. It is, as you are aware, necessary, for purposes of record and identification,

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that each message should be accompanied by a preamble, giving its official number, date, place of origin, and other particulars. As the preamble is equal to 6 or 7 ordinary words, it appeared natural to those who drew up the first tariffs that a standard message should be of such a length that its cost should cover the transmission of the preamble. In the first Paris Convention, a single rate was accordingly made to apply to a standard message not exceeding 20 words in length; two rates were demanded for a message containing from 21 to 50 words, and three for a message containing from 51 to 100 words. During the next few years the standard was altered to 25 words, and then to 15 words, with a limited free address. In the Berne Convention of 1858, the latter was discontinued, and the standard was brought back to the original number of words, with half rate for each extra 10 words, and this regulation has remained in force in Europe ever since, that is to say, for about 20 years.

But although suitable for lines in Europe, where the distances are comparatively short, and the tariff moderate, it soon became evident that a 20-word standard was ill adapted to the long lines connecting Europe with India and other distant countries. These extra European lines are very costly to construct and to maintain; their traffic consists, moreover, almost entirely of messages passing between their extreme points, the business of the intermediate stations being but insignificant. The tariff on lines of this description is therefore necessarily high, and, where this is the case, merchants, who are the most important customers, soon find that they can express the bulk of their wants in messages of very much shorter length than 20 words; in fact, by arranging a number of selected words with different meanings attached to each, they are enabled to form codes by which they can convey all their ordinary enquiries, instructions, and replies in very few words indeed. To meet the demand for brief messages beyond Europe, the Vienna Convention of 1868 allowed the extra European administrations to introduce on their lines a special message of 10 words. The Rome Convention of 1872 authorised the conversion of the special message into a standard message of 10 words, with subsequent gradation of charge per single word; and the St. Petersburg Convention of 1875 swept away altogether the restriction of the 10 word minimum, and introduced on the extra European lines a word tariff pure and simple. In fact, the European administrations recognised the word measure for extra European traffic, but retained the 20-word standard in Europe. The former is, however, now meeting with much general favour and support. It has quite lately been adopted by special agreement between Germany and Great Britain, and it is not impossible that at the London Conference it may be accepted as the normal international unit. The arguments in favour of a small standard of measurement are obvious, but naturally apply much more forcibly in the case of high than in the case of low tariffs.

It is not fair to insist on a sender paying for more work than he wishes to exact, and it is to the interest of all that the charge for a message should be as nearly as possible in proportion to the time and labour expended.

A letter tariff has been suggested, and this would, perhaps, in theory be a nearer approach to perfect accuracy than the word, but in practice it would be exceedingly troublesome, and the clerical labour entailed would be excessive.

Adverting to the tariffs, which, as I previously mentioned, were based in the International Convention of 1852 on the zone principle, I would observe that, roughly speaking, the first zone of a country was about 50 miles in breadth, and the succeeding zones about 100 miles. The charge in 1852 was 2s. per zone for a standard message, and by successive reductions was brought down to about 1s. 2d. in 1858.

In 1865 was concluded the seventh Convention on my list, generally spoken of as *the* Paris Convention, though it was, as I have shown, not the first or only one drawn up in the French capital. It acquired its repute from the length of its duration and its subsequent revisions at Vienna and Rome. On this occasion the zone system was abolished, and the principle of mean rates for each country was substituted. The tariffs were also very considerably reduced, as may be seen by taking, as an example, the 20-word charge between London and Constantinople, which in 1854 was 19s., but only 9s. after the Paris Convention.

In the St. Petersburg Convention of 1875, the principle of mean rates was, at the instance of India, somewhat further extended, so that, in the case of messages exchanged with the East, a mean rate is now collected to cover the transit over any distance in Europe. This is another principle which seems to meet with growing approval, and before long we may have a mean telegraph rate of so much per word between the different States of Europe, resembling the mean rate for letters established at the Postal Union.

The question of how far the telegraph rates can be cheapened, and this costly means of communication placed within the means of a larger class of correspondents than at present, is one of the greatest interest. Mr. Edwin Chadwick, and many other gentlemen whose opinions deserve attentive consideration, think that the time has arrived when the ocean telegraphs should be purchased by the Government, and as long ago as February, 1872, a paper giving expression to these views and to the arguments in their support was circulated by the Society of Arts. An elaborate and able essay on the subject of tariffs, a translation of which appeared in the TELEGRAPHIC JOURNAL, was written not long ago by M. Vincent, one of the most distinguished of all authorities on international telegraphy, who has for many years represented Belgium at the Conference.

It would be fallacious to assume that the conditions which govern telegraphic correspondence are precisely the same as those which affect the postal traffic. It certainly does not follow that because the charge for the transmission of a letter over long distances has been brought down to a penny or two, and the result notwithstanding has been beneficial to the revenue, therefore a reduction of the telegraph tariffs from shillings to pennies would likewise pay. Postal work can be conducted on what may be called wholesale principles; telegraphs must be manipulated one by one. The real labour of a letter is performed by its writer, while in a telegram all is done by the departmental official. Roughly speaking, the carrying capacity of postal vans and mail steamers is unlimited, while that of a wire is restricted to so many words a minute. While, therefore, I cannot suppose that we shall ever transmit our telegrams as cheaply as our letters, I still venture to foretell a gradual but steady diminution in the tariffs as at present framed. Every mechanical invention which increases the working speed of our wires must tend to remove one of the principal obstacles to the growth of cheaper telegraphy. For my part, I would even advocate the freer employment of reasonable codes: I mean those made up of words of medium length, easy to send, and not liable to error, which necessitates repetition. I am bound to say that some of the secret words now used, especially on long lines of telegraph, are the reverse of reasonable, and

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actually occupy the wire and worry the clerks far more than would the transmission of the full sentences for which these bewildering words are abbreviations. I should like to give you instances of some of the remarkable conglomerations which have come under my notice, but the time at our disposal would hardly admit of my spelling out any of the very long specimens.

A remarkable paper on the law of international telegraph traffic, by Mr. C. L. Madsen, our local honorary secretary for Denmark, was read before this society in April last. The object of that paper is to show the existence of a fairly uniform mathematical relation between the commercial and the telegraphic traffic of the several States. The entire question is one which deserves close and careful study.

Attempts have been made at different times to induce the Governments of Europe to declare the submarine and land lines of the world neutral in time of war. The United States, I believe, addressed a circular note on the subject, about seven or eight years ago, to the different Cabinets, and at Rome, in 1872, Mr. Cyrus Field, as representing the telegraph interests of America, laid the matter before the Conference, with a view to the insertion of some protective clause in the International Convention. The delegates, while admitting the desirability, from a philanthropic point of view, of such neutrality, if practicable, considered the discussion of the question to be beyond their functions. They, however, inserted a note in the *proces verbaux*, drawing the attention of their Governments to the application. Nine Governments replied: some commenting in a general way on the civilising tendency of the proposal, others referring to the replies they had previously sent to Washington. The result, as might perhaps have been anticipated, was that no decisive action has been taken in the matter.

I need not dwell at any very great length on the many other modifications which have been introduced into the Conventions of later years. They may be thus roughly summarised:—

The principal international offices must now be kept open throughout the twenty-four hours, and all extra night charges have been done away with.

A very large number of languages are now accepted as suitable for correspondence, it being, however, stipulated that every message when tendered be clearly written in the Roman character.

Permission is now freely accorded to all to employ cipher, or secret language.

The maximum length of a word which at first was no less than 7 syllables, is now 15 letters on the European, and ten letters on the extra European systems.

The franc has been universally accepted as the monetary unit in which all international accounts have to be prepared.

Rules have been drawn up to improve and regulate semaphoric communications with vessels at sea.

A complete system has been devised for the uniform settlement of traffic accounts between the several administrations, and sundry permissive clauses have from time to time been inserted, allowing separate administrations to make among themselves special arrangements which do not affect the other contracting States. This covers the introduction in some systems of what are called "emergent" messages, at treble rates, having the advantage of priority of despatch, also, on the other hand, of a cheaper class of despatch written on telegraph cards. The States are also empowered, if they please, to introduce, for the use of the Press, a system of subscription for the employment of unoccupied wires at reduced rates during certain hours of the night.

Every Convention since that of Brussels has been translated by Mr. Alfred Brasher, Superintendent in the Indo-European Telegraph Department. The translations were first made for the use of the Indian Telegraph officials only, but for the last ten years the Secretary of State has authorised their publication, and they have been adopted by the Post Office, the English companies, and, in fact, by all the English-speaking telegraph administrations in the world, without, so far as I know, any impeachment of their accuracy.

The headquarters of the International Telegraph Administration are at Berne, and the business has been for many years past conducted by M. Curchod, a gentleman of consummate tact and industry. His duties are by no means light, and I may say that the ability and courtesy with which they have been executed are gratefully recognised by every department concerned.

This central bureau receives and circulates notices of the opening of all new lines and stations, as well as of all interruptions and their rectification. To Berne are addressed all proposals for modification of rules or tariffs, which are then formulated and sent on to the different administrations interested. At the Berne office, too, are prepared new international tariffs and revised telegraph maps. It publishes a telegraphic journal, and the arduous task of arranging the materials for every fresh conference lies with the director, who invariably attends in a consultative capacity.

The expense of maintaining this central office at Berne is borne by the contracting States in different proportions, according to the importance of each administration.

Before the members of the conference disperse, they decide by vote where the next assembly shall take place. I am rather inclined to think that the conferences recur at too short an interval, and that a meeting once every five years would now be quite sufficient. Some twelve months before the date fixed for the new conference, the head of each administration is called on by the director of the central bureau to forward to Berne all proposals for change of regulation or tariff which it may be deemed desirable to discuss. The several proposals are carefully classified and circulated, so as to allow ample time for all to examine and criticise, and to make ready their arguments, whether favourable or adverse. At the appointed time, the delegates, armed with proper credentials from their respective Governments, present themselves at the selected place, and are formally received by some State Minister, who welcomes the visitors, and then instals in the presidential chair the Director-General, or some other official holding high rank in the telegraph service of the country where the conference is held. At Vienna the delegates were received by Count de Beust, and at Rome by Signor Visconti Venosta, both Ministers of Foreign affairs; at St. Petersburg by General Timatscheff, Minister of the Interior. The presidents at the three conferences were respectively M. Brunner de Wattenwyl, Signor de Amico, and General von Luders, and it would be hard to say to which of these admirable officers should be awarded the palm for the complete success which attended the arrangements.

It is obvious that a very great deal depends on the personal qualifications of the president, in whom should be combined patience, firmness, and courtesy, with a thorough knowledge of all the requirements of the telegraph organisations. He should, moreover, possess an intimate acquaintance with the actual working of the international rules.

I should here state that the British companies, to whom telegraphy owes so vast a debt, were strongly represented at Berne, Rome, and St. Petersburg. They had no voting power, but were at liberty to express their views fully and

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freely, and I am sure they had no cause to complain of want of support or of inattention to their requirements.

The system usually followed at these conferences is to tell off the thirty or forty delegates into committees. One committee occupies itself with the revision of the rules, a second with the arrangement of the tariffs, and a third with the task of editing the Convention as a whole. The ordinary duration of a conference is from one to two months. The members meet three or four times a week, each sitting lasting from about ten in the morning until five or six in the evening. The work of the committees occupies the by-days. Throughout the deliberations the French language only is employed. These international telegraph conferences by no means consist of "all work and no play." At Rome and St. Petersburg every effort was made to entertain the visitors, and all the sights of these two capitals were thrown open to us. Banquets were given in our honour at the royal tables; special nights set apart for us at the operas, and so on. In Italy we were carried off in a body to Naples, and *fêted* most hospitably. A special excavation was arranged for us at Pompeii, and some amazing antiques and bronzes were brought to the surface. If I did happen to hear a few somewhat sceptical remarks about the authenticity of these treasures, I can at least honestly vouch for the genuine character of the sumptuous breakfast we found laid out in one of the pleasantest courts of the ruined city. In the same way, when in Russia, after we had for weeks enjoyed unbounded hospitality at the capital, we were invited to Moscow, and there received in the kindest way by the Prince-Governor and the local magnates.

I hope I shall be forgiven for having devoted a few words to what may be termed the festive aspect of these assemblies; but I consider that these agreeable reunions after the day's labour are of importance, and materially help the business of the conference. They tend to bring the delegates together, and many a hitch, which has appeared formidable at the ceremonious meeting in the morning, has been smoothed away by a friendly conversation over the evening cigar. Moreover, I wish to express my hope that the members of the conference of 1879 may be given in London the same cordial reception that they have experienced elsewhere; and I am happy to say that there is little doubt but that the Telegraph Engineers' Society will be well to the front in heartily welcoming our coming guests.

RISCH'S RELAY.

THE special peculiarity of this form of relay lies in the fact that it readily responds to and follows the variations in the positive and negative currents for working long land lines or submarine cables.

Fig. 1 represents a section, and fig. 2 a plan of one form of this relay. T, T^1 are two double sector tongues fixed on one axis *a*. These two tongues are either made permanently magnetic or have magnetism induced in them by the proximity of the poles of a magnet M, or they are temporarily magnetised by the line current passing through a coil 5 surrounding the axis *a*, the one tongue T being of opposite polarity to the other tongue T^1. Four coils, 1, 2, 3 and 4, arranged symmetrically with reference to the axis *a*, have their cores terminating in eccentric caps, by turning which more or less round, the distance between them and the arcs of the tongues can be adjusted. An arm A extends from the one tongue between two contact screws 6 and 7, which are on the upper end of an insulated lever arm 8 that is mounted on a pivot 9 with a light spring behind it to give friction, adjustable by a screw nut on the pivot. The coils 1, 2, 3, 4, are

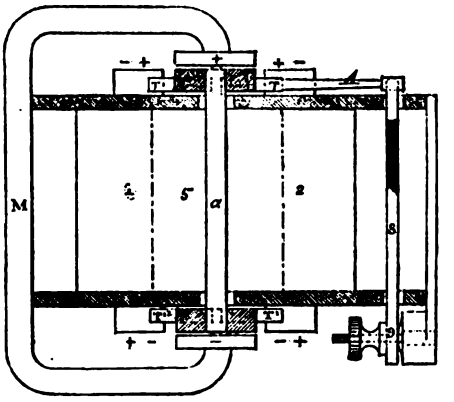

FIG. 1.

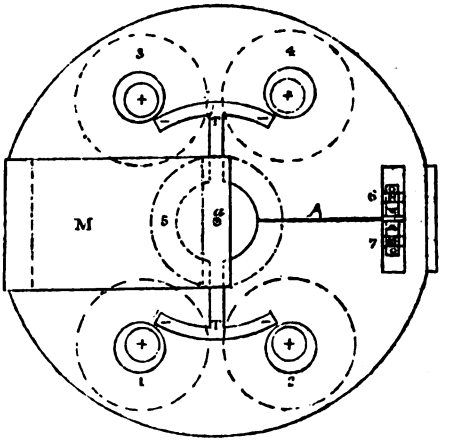

FIG. 2.

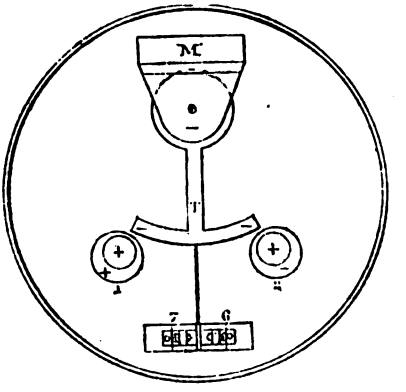

FIG. 3.

connected to the line, so that a current arriving by it increases the magnetic force of the one pair, such as 1 and 4, and diminishes or reverses that of the

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other pair 2 and 3, whereupon the sector tongues are caused to deflect to the right or left, as the case may be, and the arm A makes contact with 6 or 7. When it makes such contact, as for example with 7, a continuation or increase of current, or a succession of long continued currents, alternating with short reversals, has the effect of pressing the arm A further and further in the same direction, and the contact 7 against which it bears, is thus moved

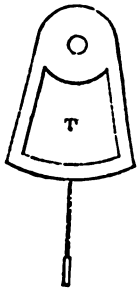

FIG. 4.

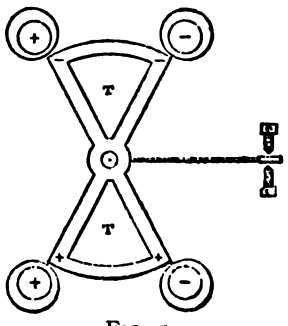

FIG. 5.

with the lever 8, bringing the other contact 6 along with it close behind the arm A, so that on a sufficient reversal of current the arm makes contact on the other side.

Fig. 3 shows the arrangement of a single sector tongue T (which may be of the form shown in fig. 4) with two electro-magnets 1 and 2, and contacts 6 and 7 on a lever, such as 8 in fig. 1.

Fig. 5 shows another form of double sector tongue operating with four electro-magnets.

SOME EFFECTS OF AMALGAMATION.

By F. HIGGINS.

MERCURY, although electro-negative to zinc in a voltaic combination, has the property in common with palladium, platinum, and nickel, of absorbing hydrogen, and assuming in consequence, the electro-positive polarity of the metal with which it is associated, provided that the potential be insufficient to disengage the hydrogen in the gaseous form.

A couple, consisting of amalgamated zinc and mercury, excited by sulphuric acid solution, will generate a current for a time dependent on the extent and nature of the surface of the mercury. This current will gradually diminish and cease, only from the assimilation of polarity caused by the absorption of hydrogen by the mercury.

If the mercury be pure and its surface smooth, the polarisation is much more complete than if it be rough, or contain any metal which is not very soluble in it, such as copper. In this latter case, the impurity floats to the surface in a finely divided state, and exposes points which greatly assist the formation and disengagement of bubbles of hydrogen.

Even when this roughness is caused by an excess of zinc, the mercury only very slightly protects the zinc from solution. On the other hand, the presence of lead or tin, which are very soluble and form smooth amalgams, does not appear to prevent the polarisation of the mercury, and does not facilitate the evolution of gas.

The action of an amalgamated zinc plate in a battery is probably, therefore, to a great extent of a secondary nature. The mercury dissolves and exposes zinc to the action of the acid, a voltaic couple is thus formed between the zinc and the mercury in its vicinity; the zinc necessarily oxidised and dissolved on this account is not, however, wasted, as in the case of continuous local action, but by its combustion lays up a store of electro-positive gas in the nascent state on the surface of the mercury.

The action resembles in a great measure that which takes place in a secondary battery, except that the loss in translation is much less in consequence of the absence of an external circuit, the whole force of the combination being exerted within the cell.

In proof of the oregoing suppositions, it has been found that an amalgamated iron surface, polarised by being placed in contact with a fragment of zinc, acts as well as a plate of zinc of the same size,* and, while affording the same conductive power as a large plate, the waste by local action is only proportional to the surface of zinc actually employed.

This arrangement has some advantages to recommend its employment, one of which is that the positive plate, or rather connection, can be a fixture in a battery, and may be in the shape of an amalgamated wrought or cast-iron cup, into which zinc may be dropped as required. Such a cup would be indestructible if kept supplied with zinc.

The diminution of internal resistance which may be thus effected in batteries is of great consequence: like the friction in a steam engine, the less there is of it the more power there is available for useful work without increased cost. But the most useful application of this property of amalgamated surfaces is to the protection of the connections of zinc plates from destruction.

An iron wire cast into a zinc plate will outlast the zinc; copper, on the contrary, is frequently attacked near the surface of the liquid, and the amalgamation of copper causes a steady destruction of zinc by local action from the before-mentioned property which it possesses of roughening the surface of the mercury in which it is dissolved.

If it were possible to amalgamate the armour of submarine cables it might perhaps increase their durability. Or the inner sheathing employed to resist the attacks of the teredo might be of a thin ribbon of amalgamated galvanised iron, which would have the great advantage over copper of not hastening or assisting the decay of the iron wires when, as would most likely be the case after the cable had been submerged some time, the two sheathings should come into contact.

RAPIEFF'S ELECTRIC CANDLE.

As soon as the ingenious discovery of Mr. Jablochkoff's "Electric Candle" was made known to the world, the attention of many electricians was

* This is only correct within certain limits. The zinc exerts its influence promptly over a radius of two inches, but more slowly as the surface is enlarged.

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directed to it as the simplest existing electric lamp, with a view of ascertaining its real merits and defects. Early in the year 1877, M. J. Rapieff had an opportunity of making a series of experiments with the new candles, the generator of the current being an "Alliance" machine with six discs. On comparing the results obtained with the "candles" and the Serrin regulator, fed by the same machine, he found that the illuminating power of the "candle" in its best conditions (3 candles) was at least one-third less than that of the light produced by the regulator. The steadiness of the light also was far from being satisfactory, although the occasional *momentary* flickerings were less noticeable in the candle than in the regulator; but the *gradual* decrease and gradual increase of the candle light was very marked, and the worst feature of all was the continuous variation in the tint of the light, from dark crimson to bluish green and violet. The chief merit of the candle was supposed to reside in its insulating strip of kaolin, as increasing the illuminating power of the voltaic arc, and preventing the flickering, thus making the electric light for the first time steady; but it was obvious that the defects of the "candle" lay almost entirely in this insulating substance. The kaolin strip being heated in the voltaic arc to incandescence, ceased to be an insulating substance, and became a conductor, and thus only a part of the current was utilised for producing the light, the remaining part passing

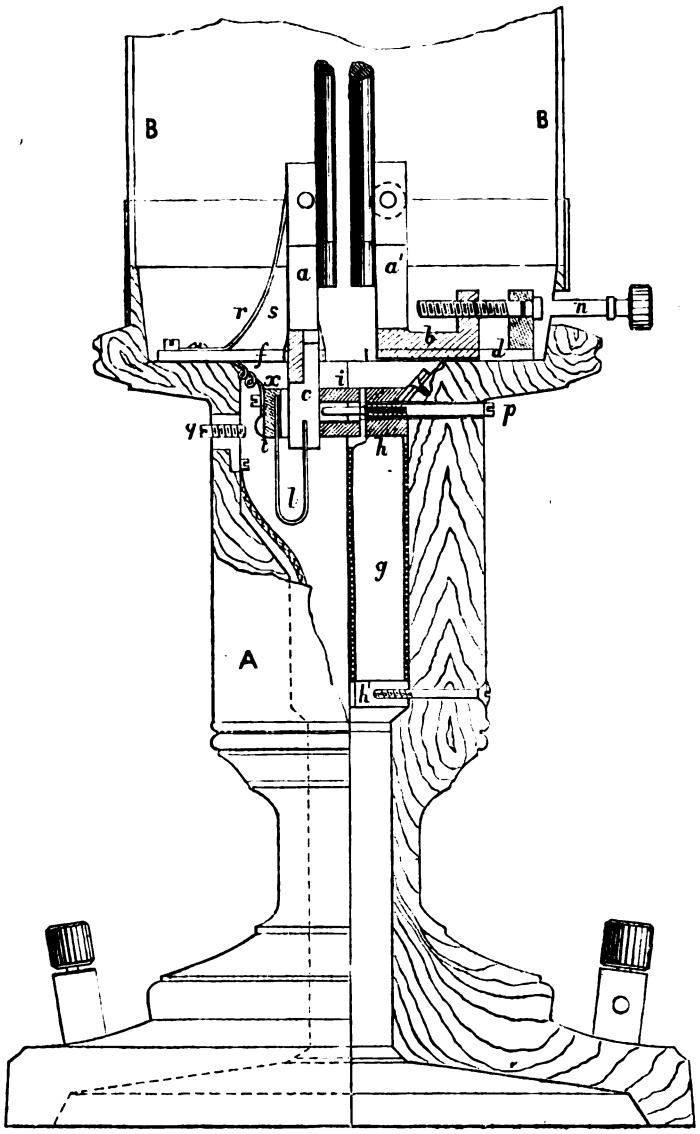

FIG 1.

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through the kaolin strips. The loss to the illuminating power of the candle so caused was also observable in the so called Jablochkoff's "Kaolin Light." This was the first application of the well-known physical fact that the most perfect insulators—such for instance as earthy substances—when heated, become more or less conductors, and M. Jablochkoff practically demonstrated this law by preparing a lamp, in which a sharp edge of a kaolin strip was brought to incandescence by means of a current of very great electro-motive force, supplied by an induction coil.

These considerations led M. Rapieff to construct a candle without any insulating material between the carbons, and he soon found that the voltaic arc tends of itself to keep the highest position between the free ends of the carbon points. This tendency of the arc is explained, first, by the draught of hot

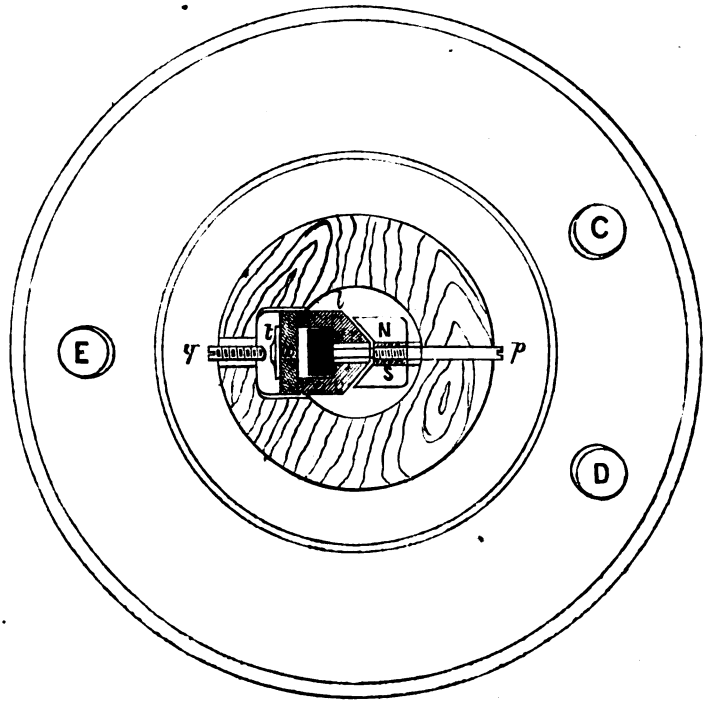

FIG. 2.

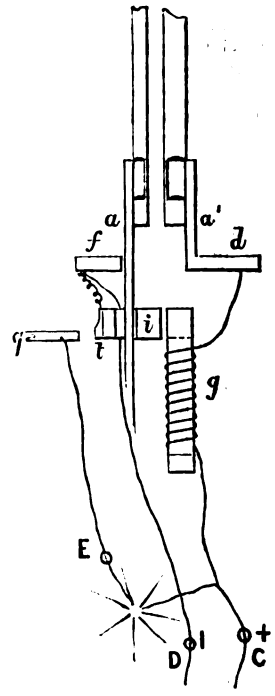

FIG. 4.

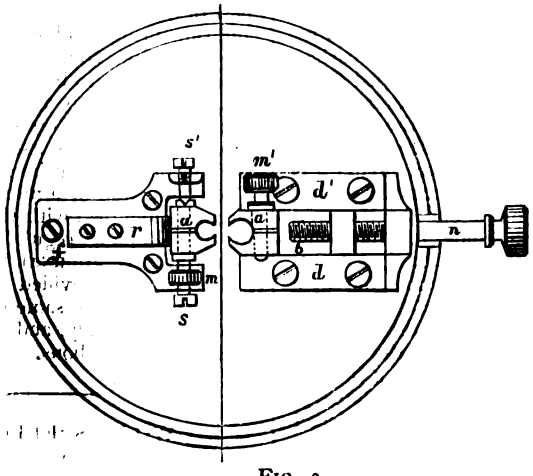

FIG. 3.

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air caused by its heat, which draws it to the upper part of the carbon points, and, secondly, by the well-known law of electro-dynamics, according to which a finite movable current approaching a fixed infinite current is compelled to move in a direction parallel and opposite to that of the fixed current; and, on the other hand, if the movable current tends from the fixed current, it is acted on so as to move parallel to the current, and in the same direction. Thus let us call the two carbon rods forming the candle *a* and *b* respectively, and suppose that the current is ascending in *a*, and descending in *b*. Then both carbons may be considered as a pair of infinite parallel currents of opposite directions, between which a movable current representing the voltaic arc is placed, the direction of the latter being evidently from *a* to *b*. According to the above law, the finite current must move towards the free ends of *a* and *b*, the movement taking place in the same direction by the action of both infinite currents, and this irrespective of the pole by which the current enters first. This proves that wherever the voltaic arc is formed between two parallel carbon rods, and whatever may be the direction of the current, which may be continuous or alternating, the voltaic arc will shift until it has reached the free ends of the carbons. But if the candle be placed upside down, the directive force of both infinite currents applied to the voltaic arc either partially or wholly neutralised by the ascending draught of air, and the position of the lighting point is rendered unsteady.

M. Rapieff filed a specification for a patent (No. 4432) on November 24th of the same year, wherein he clearly described his simplified candle, and early in the year 1878, he constructed his improved "candlestick," provided, as are all the other apparatus of this inventor, with a "safety circuit." The accompanying drawings give all the details of this electric lamp.

The two carbon points of equal cross section for the alternative current, and one double the section of the other for the direct current, are placed in the carbon holders *a* and *a'* (fig. 1), and fastened by means of milled screws *m* and *m'* (fig. 3). The carbon holder *a'* is provided with a projection shaped like a dove-tail, sliding between two brass plates *d* and *d'*. A set screw *n*, enables to regulate the distance between the carbon holders, and consequently the length of the voltaic arc. The carbon holder *a* is is pivoted on conical screws *s* and *s'*, making part of the plate *f*, the latter having a cut for the free passage and movement of the holder *a*. Its lower part *c*, is made of some insulating material, as wood, vulcanised fibre, or ebonite, and connected by a steel spring [illegible] the iron armature *i*. The base plates of the [illegible] *f*, and *d d'*, are screwed to the upper part of the wooden stand *a a*, in the form of a vase, which is fitted with terminals C, D, E (fig. 2). An electro-magnet, formed by two iron plates *g*, with a cross piece of the same material *h'*, is placed inside of the wooden stand, the upper part *h* of the two cores being shaped in a peculiar manner, as may be seen in fig. 2, showing the two poles N and S of the electro-magnet. This shape of the poles is found by M. Rapieff to be the most convenient and compact in order to secure the maximum of attractive power for comparatively large variations of the distance between the poles and the armature. The latter is an iron block, shaped like a horse-shoe, corresponding with the polar surfaces of the electro-magnet, thus allowing a free movement of the lower part of the holder *a*. A plate *k*, made of an insulating material, is fixed to both ends of the horse-shoe shaped armature, and this plate bears a metallic contact piece *t*, which, when the apparatus is not in action, presses against the copper screw *q*. Another screw *p*, goes through the brass piece *h*, and is intended to regulate the distance between the poles of the electro-magnet and the armature. Finally the carbon holder *a* is always pressed, when the current is not flowing through the carbon, by a brass spring *r* towards the other holder.

The connection of the different parts of the lamp and the terminals is illustrated in fig. 4. The positive and negative ends of the leading wires from a dynamo-machine, or a cell battery, are respectively attached to the terminals C and D. The current from C flows through the coils of the electro-magnet into the carbon holder *a*, then through both carbon rods into the carbon holder *a*, and the plate *f*; this latter is in metallic connection with the contact piece *t*, and their terminal *d*. The screw *q* is in connection with the third terminal E.

From the above explanation, the action of the lamp may be easily understood. When no current is flowing through the apparatus, the spring *r* causes the ends of the carbons to touch each other, and at the same time the armature is pressed by the contact piece *t* against the screw *g*. Immediately the current is let in, part of it flows through the electro-magnet, and the remaining deviates by way of the terminal E, screw *q*, contact piece *t*, bottom plate *f*, and escapes through the terminal D, joining the other part of the retiring current. This first inlet of the current magnetises, although feebly, the electro-magnet which begins to attract the armature *i*. By this, the derived circuit C, E, *q*, *t*, *f*, is broken, and now the whole current acts on the electro-magnet, and therefore on the armature *i*; the comparatively thin spring *l*, presses upon the lower part of the carbon holder *a*, overcomes the spring *r*, and thus brings both carbons into a parallel position by which the voltaic arc is established. When a reserve lamp is to be used, both terminals C and D of the second lamp, are connected respectively with C and D of the first (as shown in the fig. 4) and the reserve lamp lights itself automatically as soon as the carbons of the primary lamp have burned down. The connection of a number of such lamps in one circuit is identical with the arrangement employed for the Rapieff regulator, as described in the TELEGRAPHIC JOURNAL for November 1, 1878.

The lamp is provided with an opaline cylinder B, and a cover of the same material, as shewn in fig. 1. The light is steady, and lasts for about two hours without fresh carbons.

WILDE'S ELECTRIC CANDLE.

By HENRY WILDE.

IN a former communication to the Society,* I directed attention to the fact, that when the electric light is produced from the ends of two carbon

* See Proceedings of the Manchester Literary and Philosophical Society, Oct. 29, and Nov. 26, 1878.

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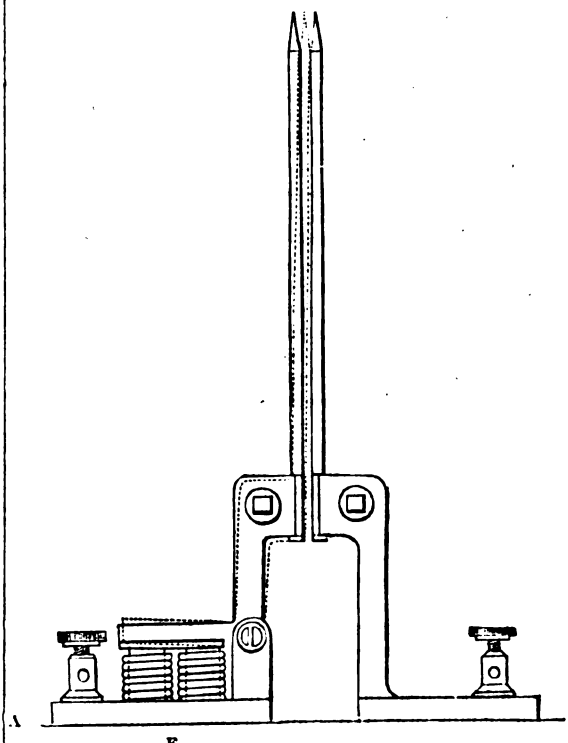
pencils placed parallel to each other, if the strength of the electric current, the thickness of the carbons, and the distance between them are rightly proportioned, the carbons will burn steadily downwards until they are wholly consumed, without any insulating material between them. To initiate the light by this method, it is necessary to complete the electric circuit between the carbons by means of some conducting substance, which volatilises on the passage of the current, and establishes the electric arc between the points.

When a number of such lights are produced simultaneously from the same source of electricity, any interruption in the continuity of the current extinguishes all the lights in the same circuit, and each pair of carbons requires to be reprimed before the lights can again be established. This defect, as will be obvious, would cause great inconvenience when the lights are not easily accessible, or are at considerable distances apart.

In the course of my experiments it was observed that when the electric circuit was completed at the bottom of a pair of carbons close to the holders, the arc immediately ascended to the points, where it remained so long as the current was transmitted. My first impression of this peculiar action of the arc was, that it was due to the ascending current of hot air by which it was surrounded. This however was found not to be the cause, as the arc travelled towards the points in whatever position the carbons were placed, whether horizontally or vertically in an inverted position. Moreover, when a pair of carbons were held in the middle by the holders, the arc travelled upwards or downwards to the points, according as the circuit was established above or below the holders. The action was in fact recognised to be the same as that which determines the propagation of an electric current through two rectilinear and parallel conductors submerged in contact with the terrestrial bed, which was described by me in the *Philosophical Magazine*, August, 1868.

In all the arrangements in general use for regulating the electric light, the carbon pencils are placed in the same straight line, and end to end. When the light is required, the ends are brought into momentary contact, and are then separated a short distance to enable the arc to form between them. The peculiar behaviour of the electric arc when the carbons are placed parallel to each other, suggested to me the means of lighting the carbons automatically, notwithstanding the fact that they could only be made to approach each other by a motion laterally, and to come into contact at their adjacent sides. To accomplish this object, one of the carbon holders is articulated or hinged to a small base plate of cast iron, A in the figure, which is so constructed as to become an electro-magnet when coiled with a few turns of insulated wire. The carbon holder is made in the form of a right-angled lever, to the short horizontal limb of which is fixed an armature placed over the poles of the electro-magnet E. When the moveable and fixed carbon holders are brought into juxtaposition, and the carbons inserted in them, the upper parts of the two carbons are always in contact when no current is transmitted through them, as shewn by the dotted lines in the engraving.

The contact between the carbons is maintained by means of an antagonistic spring inserted in a recess in one of the poles of the electro-magnet, and reacting on the under side of the armature. One extremity of the coil of the electro-magnet is in metallic connection with the base of the carbon holder, while the other extremity of the coil is in connection with the terminal screw at the base of the instrument from which it is insulated. The coils of the electro-magnet are thus placed in the same circuit as the carbon pencils.



WILDE'S ELECTRIC CANDLE.

When the alternating current from an electro-magnetic induction machine is transmitted through the carbons, the electro-magnet attracts the armature and separates the upper ends of the carbons, which brings them into their normal position, and the light is immediately produced. When the circuit is interrupted, the armature is released: the upper ends of the carbons come into contact, and the light is produced as before. When several pairs of carbons are placed in the same circuit, they are, by this arrangement, lighted simultaneously.

REPORT ON ELECTRIC LIGHT EXPERIMENTS.

By LOUIS SCHWENDLER.

THIS report was instituted on behalf of the Board of Directors of the East Indian Railway Company, the object being to determine whether the electric light could be employed with advantage for lighting the stations of the company.

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The questions which Mr. Schwendler set himself to answer by *direct experiment* were five in number, viz. :—

I. Quantity of light per unit of power, unit of speed, and unit of money (first outlay).

II. Constancy and Regularity of the electric light.

III. How to put up the light—position and mechanical details.

IV. What repairs are required in course of time, and are they of such a nature that an ordinary mechanic can execute them.

V. Routine; difficulty of manipulation and superintendence.

To solve the first question four different dynamo-electric machines producing a current in *one* direction, were tried, viz. :—

1 Siemens' medium or A size.
1 Do. small or B size.
1 Gramme (workshop pattern) C.
1 Do. with two sets of brushes, D.

The results of trials of these machines shows that they answer for the electric light, but that their power of producing light has been *overrated*, and the horse-power required to drive them *underrated;* but still the light produced by any of the machines is *at least* fifty times cheaper than the same amount of light produced by combustion. This relation only holds good, however, as long as *one* light is produced by *one* machine.

Machine A was found to be about twice as effective and economical as any of the other three machines, which latter were about equal in efficiency.

The favourable result from the A machine was due to its low internal resistance, and its low speed of working.

As regards question II, two lamps were tried, viz., the *Serrin* and the *Siemens;* of these the former was found to be the best. It was found that a great cause of irregularity in the burning of the lamps was the want of homogenity in the carbons.

Under the head of Question III., Mr. Schwendler gives his opinion that the *division* of the electric light is impracticable, except at a heavy loss. He considers the best way to diffuse the light is to throw it upwards by means of a *silvered glass* reflector on to a white ceiling or other convenient white surface.

The points considered under Questions IV. and V. were not unfavourable to the electric light system. The only repairs which seemed likely to be necessary were those affecting the brushes. The lamps were not likely to require much or difficult repairs. One skilled mechanic of rather high intelligence would be sufficient to look after the machines and lamps at any station.

Appendix I., which follows the general questions considered, gives a "General Specification of a Dynamo-Electric Machine required for use in India." The machine recommended is the A form, the induction cylinder being wound with twelve separate sections of wire. The speed of driving is to be from 700 to 750 revolutions per minute, and at that speed, through a known external resistance, the current produced *should not be less* than that given by the following formula :—

$$c = 0{\cdot}3\sqrt{\frac{w_1 - w_1}{m + r}}$$

where

c = current in webers;
W_1 = power in Meg. Ergs.* required per second to produce current c;
w_1 = power in Meg. Ergs.* required per second to drive the machine with the circuit open;
m = internal resistance of machine, } both in Siemens' units.
r = external resistance " }

The formula given allows a loss of 12 per cent. of power in producing the current.

The specification for the lamp states that the carbon holders are to be of the form adopted in the Siemens' lamp. With 18 mm. carbons the lamp should burn eight hours.

The electro-magnet which pulls the arc should not offer a greater resistance than ·02 Siemens' units. It is to be shunted with another electro-magnet of the same resistance. The amount of iron used in the electro-magnet should be such that at the mean distance of the electro-magnet from its armature the magnetic force is strong enough to produce an arc of 2·5 mm. against the mean tension of the spring when employing a current of 25 webers. The magnetic action of the shunt should be about double that of the lamp electro-magnet. The object of the shunt is to give the regulation movements great quickness, the currents from the magnets neutralising one another.

For adjusting the equality of the extra currents the following method is recommended :—

"Form a Wheatstone bridge two sides of which are formed by a mercury-rheostat, each side offering about 0·02 S.U. resistance. The third side of the bridge is formed by the electro-magnet of the lamp, the fourth side by the shunt. In one diagonal place a dynamo-electric machine and about *one unit* resistance, together with a convenient make-and-break contact, best done by a mercury cup. In the other diagonal, place a Bell-telephone of lowest possible resistance. One end of this diagonal can be moved along the mercury-rheostat. Start the dynamo-electric machine, listen to the telephone and alter the ratio of the mercury-branches of the bridge, by shifting along the contact until the telephone is perfectly silent.

Then if, at commencing and stopping the current a strong click is heard, we know it is due to the two extra currents not being equal, and as we further know that the shunt produces the greatest extra current, we make this extra current smaller, by shifting along the two poles of the shunt, an iron wedge until the telephone is quiet, when starting and stopping the current. The iron wedge is then fixed in its position."

In Appendix II., Mr. Schwendler considers the special conditions and information concerning the introduction of the electric light in India. The engine power for driving four dynamo-machines is not to be less than 25 horse-power. The speed indicator recommended is that of Napier.

(To be continued.)

* 7460·6 Meg. Ergs. per second, equal 1 horse-power per second.

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Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

CLERAC'S TUBE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Permit me on the occasion of a discussion now going on in your journal between Prof. Hughes and Prof. Barrett on the subject of the variable resistance carbon tube of M. Clerac, to inform you that I possess irrefutable proof of the existence of this tube which has been used since the year 1865 by M. Clerac, *employé* of the *Administration des lignes Telegraphiques Francaises*. One of the proofs is a letter of Prof. Hughes, dated 1866, in which he expresses his satisfaction at having in his possession a rheostat so simple and portable, whose indications are sufficiently exact for practical purposes. This letter bears the post mark, 1866. It runs as follows:

"Paris, Mars 4, 1866.

"MONSIEUR CLERAC,—Veuillez me faire construire quelques-uns de vos tubes de resistance variant de 100 jusqu'à 1000 kilometres.

"L'idée me parait excellent sur le rapport de l'economy, simplicité, et absence d' induction et polarization.

"Acceptez mes félicitations pour une si bon et simple invention.

"Sincèrement a vous,

[Pour copie conforme, "D. E. HUGHES.
M. du Moncel.]

I also heard of it myself at that time, but did not pay much attention to it, having regarded it as a consequence of the discovery that I had made in 1856 of the variation of the conductivity of semi-conductors under pressure. What astonishes me is that Professor Barrett, in a very good article on the Microphone in *Good Words* for October, 1878, expresses *himself as follows*:—

". . . . This, however, is not quite the case, for so long ago as 1856 Count du Moncel, a well known and most indefatigable French electrician, whilst investigating the electric resistance between the points of contact of two conductors (that is the greater or less freedom with which the current passes) found that the strength of the transmitted current varied with the amount of pressure exerted upon the surfaces in contact. Furthermore, in experimenting with brass, iron, platinum, and carbon conductors, M. du Moncel found that the effect of variations in pressure was most marked in bodies that had the highest electrical resistance; that is to say, in the worst conductors. Ten years later, in 1866, M. Clerac employed the foregoing principle in order to construct a simple machine for altering the strength of the current in a given circuit. This instrument, technically known as a rheostat, consisted of a tube filled with ordinary black lead or powdered carbon, and more or less compressed by a piston which was moved by a screw. In this way the resistance of the circuit in which the tube was introduced could be altered at pleasure."

At the time he wrote that, Professor Barrett took a right view; but since then he has allowed himself to be persuaded aside from it by M. Zetzsche, who, on this occasion as on several others, has shown that he is above all a Prussian, and wishes to claim all inventions for his own country, and who ought, however, to recall the proverb, "He who would prove too much, proves nothing."

I regret that Professor Barrett, for whom I have the greatest esteem, should allow himself to be impressed by Professor Zetzsche's claims, and that, contrary to his habits, he has gone astray. I can send him, should he desire it, the letter quoted above, which was in my hands before I published my note upon the ill-founded pretensions of Mr. Edison to that discovery.

I beg you to accept the assurance of my most distinguished sentiments,

DU MONCEL.

SIR,—Having read in your valuable paper the letter of Professor Hughes concerning Clerac's Variable Resistance Carbon Tube, I should like to be allowed to state what I know of the case. While perusing the account of Mr. Edison's inventions in the *Times* of the 2nd inst., I was astonished to read that—

"It has been said that Mr. Clerac discovered this ten years ago, but Professor Barrett has found no trace of this."

Well, as I had seen such a tube frequently used at our office by Professor Hughes, in a great many experiments which were made for the establishment of his instrument, in our communications with Paris and Amsterdam, I reminded him of the fact; but he (Professor Hughes) had forgotten that he had made use of this tube at our office.

With regard to the period when the Clerac tube was used by him, I am quite positive; for the reason that the communications with Paris and Amsterdam with the Hughes' instrument were officially opened on one of the first days of November, 1871 (the 4th, I think); and as it was during the preliminary experiments which were made daily for more than one month previous to that date that Professor Hughes used Clerac's tube, it must certainly have been in the course of October, 1871.

I remember very clearly that on one occasion Professor Hughes, requiring some external resistance, asked me if I had anything of that kind, and, on my negative answer, he produced a small tube four or five inches long, which he said would do. Naturally I asked him what it was composed of. "Simply," he replied, "of powdered carbon. It is the idea of Mr. Clerac" (a French employé at Paris, whom I knew by name as having attended Mr. Hughes' experiments).

Professor Hughes did not seem then to attach very great importance to it, except, as he explained to me, that it was a resistance variable according to pressure.

Subsequently I had occasion to see it used for the same purpose by Professor Hughes almost daily for a length of time, so that it is so clearly in my recollection that, although, more than seven years have elapsed, I am sure I could pick it, without hesitation, out of a hundred if it was again presented to me. Therefore I am happy to testify to the existence of this Variable Resistance Carbon Clerac Tube as far back, to my certain knowledge, as the dates above-mentioned.

F. DESPOINTES,
Superintendent Submarine Telegraph Co.
58, Threadneedle Street, London, E.C.
January 21st, 1879.

[The following letter reached us just in time for insertion in this number.—ED. T. J.]

SIR,—I am glad that Professor Hughes has, by his courteous letter in your last number, drawn attention to the statement made in a recent lecture in London and correctly reported in *The Times*, that I can find no trace of Clerac having made a carbon rheostat the resistance of which could be varied by pressure. Prof. Hughes' letter enables me to place before your readers the grounds on which I made the foregoing assertion. Anxious to arrive at an independent judgment upon the regretable dispute which arose upon the

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discovery of the microphone, I made diligent search to find a record of Clerac's resistance tubes, which according to Prof. Hughes involved the principle Edison claimed when discovered. Count du Moncel's works and other authorities were searched in vain. At last a mutual acquaintance of Prof. Hughes and myself referred me to the *Journal Telegraphique* of Berne for 1874. To this I turned, and the following is the quotation from that journal for March 25th, 1874:—

"Dans son etude sur l'exposition historique de l'administration allemande, M. le Professeur Zetzsche parle, sans en indiquer l'origine de rheostats se composant de poudre de graphite comprimes dans des tubes de verre, qui seraient employés en Allemagne depuis 1865 dans les stations intermédiaires pour régler les résistances de la ligne (voir No. 26, du 25 Fevrier dernier, page 406.) M. Clérac, directeur des transmissions de 1re classe à l'administration des télégraphes français, nous écrit à ce sujet pour nous faire observer que ce rheostat est d'invention francaise et n'a pas été applique en Allemagne avant 1866. C'est M. Clérac qui vers la fin de 1865 à imaginé d'employer ainsi le charbon pilé et comprimé dans des tubes de verre, pour remplacer dans certains cas les bobines de résistance en fil de maillechort et c'est M. le Professeur Hughes qui frappé de la simplicité et de l'économie de cette invention, l'importa en Allemagne l'année suivant. Depuis, les rheostats à poudre de graphite ont été perfectionnés en France par la substitution de tubes en ébonite aux tubes de verre, ce qui simplifie la construction et augmente la constance."

It will be observed that there is no reference to any variable pressure exerted on the powdered graphite, it is simply stated that the carbon is "*compressed* in glass tubes as a substitute for resistance coils of German silver wire; and that Professor Hughes, struck with the simplicity and economy of the invention, introduced it into Germany the following year (1866)." Turning to the reference given in the quotation, we find in No. 26 of the same journal, these carbon rheostats spoken of as made to give a certain definite and permanent resistance. The obvious meaning of the passages in the *Journal Telegraphique* is that carbon rheostats of *constant pressure* and variable length were employed by Clerac; so that, unless there exists other documentary evidence of which I am unaware, I consider myself justified in asserting that to Edison is due the discovery of a carbon rheostat of *variable pressure*, with practically constant length, and that I could find no trace of Clerac having invented an instrument of this kind.

I was confirmed in this conclusion by the fact that before the lecture to which Professor Hughes refers I had published a similar opinion in a letter to the *Times*, in an article in *Nature*, and in a communication to the Physical Society. My statement not having been challenged, I have been much puzzled to account for the contrary opinion held by Professor Hughes, and felt sure either that some misunderstanding on his part existed, or that, more probably, I was ignorant of the whole facts of the case.

In his letter to your journal, Prof. Hughes states, what indeed I have heard before, that he has in his possession one of Clerac's variable resistance tubes, and that it has been seen by many. This I do not doubt. But I question whether this amounts to publication in the scientific sense, and further, it is important to know through what range of resistance this tube can be made to vary by simple pressure. On this point I may quote a letter I received some little time ago from Mr. Edison, to whom I had written, expressing my conviction that a misapprehension was at the root of the unfortunate controversy that had arisen, at the same time venturing to hope that he would feel justified in recalling the strong words he had used, as I understood Prof. Hughes had shown to several friends one of Clerac's original variable resistance tubes of carbon. Mr. Edison replied: "The statement that Clerac made resistance tubes with carbon, the resistance being varied by pressure, and which were said to have been used to regulate the resistance of telegraph lines, cannot possibly be true, for the reason that the amount of resistance that would be thrown in and out of the lines by the difference of pressure would be so small as not to be detected by any apparatus worked on telegraph lines. I have tried tubes of every size and character, with carbon in every degree of division, and no Morse apparatus would detect the change. I am thus led to conclude this is an after thought on the part of Mr. Hughes, and one which fortunately can be proved untrue. Undoubtedly Clerac made tubes filled with carbon which were adjusted to 50, 100, 500, or any number of ohms, but that he filled tubes with carbon and obtained these resistances by varying the pressure could not possibly be true in 1866, if it cannot now be done. Nothing has ever been published that I can find where Clerac claimed this."

From this extract it will be seen that Mr. Edison had good grounds for believing that he was the first to discover and make practical use of the variation of the resistance of graphite by pressure. And whilst I cannot entertain the opinion Edison has expressed concerning Prof. Hughes, I am bound to say that it behoves the latter to make public the evidence on which he has based his claim on behalf of Clerac.

Apropos of this subject, I may mention in conclusion, that an investigation which I have now in progress, undertaken to ascertain the cause as well as the amount of the diminution of resistance in carbon by pressure, indicates that it is no physical change but simply a case of more intimate contact. Particulars of these experiments will be published shortly.

W. F. BARRETT.

Royal College of Sciences,
Dublin, Jan. 25th.

[Mr. H.—Your letter will appear in our next.—Ed. T. J.]

Notes.

THE ELECTRIC LIGHT.—Prof. Tyndall lectured on the electric light at the Royal Institution on Friday, January 17, to a house crowded from floor to ceiling, and numbering in its audience many men and women of mark and rank. As was to be expected it was a complete success, for no lecturer knows better than Prof. Tyndall how to guide the popular mind to an understanding of science by apt words and well chosen illustrations. At the commencement of the lecture he said that his object was to put before his hearers "a few solid thoughts" regarding this question of the hour. Those who attended the lecture under the impression that the fate of fortunes hung on Prof. Tyndall's words, and saw in this statement a confirmation of their belief that he would give the law in the question of Gas *v.* Electricity, were doomed to disappointment, for the lecture was merely a masterly exposition of the origin, rise, and present state of electric lighting, and the lecturer merely echoed what all electricians conversant with the subject have held, namely, that the electric light would soon illuminate our streets, factories, and open spaces, and "*possibly* also" our homes. In fact, Dr. Tyndall said that he had come there that evening firmly resolved not to say a word that would influence gas shares if he could help it. As regards Edison's light he was prudently reticent, and took the position that as it was not yet

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published he could not deal with it then, though at a future time he might. But, at the same time, he insisted on the erroneousness of terming Edison's light a "discovery," as is frequently done by our well-meaning friends, the newspaper reporters. It may be an invention, but it cannot be a discovery, says Dr. Tyndall, for all the laws of the subject have long been known. We will not stop to question this remark. The lecture was illustrated by diagrams and examples of all the principal magneto-electric machines, from Faraday's original arrangements up to the machines of Gramme, Siemens, and De Méritens, the latter of which he praised very highly, and proclaimed as a formidable rival to the two former ones. Various electric lights were also shown, the candles of Rapieff, Wilde, and Jablochkoff, and the arcs of Rapieff, Siemens, and Serrin. These experiments passed off very favourably, and we observed that the lamp of M. Rapieff, during the whole time it was exhibited (some minutes), did not give a single flicker. A large electric lamp hung from the ceiling, and, fed by a Siemens' machine, lit up the entire hall during the lecture, except when gas was required for producing what we may call a dim experimental light. The most interesting and beautiful of all the lights shown was, however, the irridium light, and being entirely unconnected with what Prof. Tyndall had to say about Edison's results, it was virtually a kind of side illustration of his doctrine that Edison has made no discovery. A small piece of irridium wire (which nevertheless was priced at £30) was heated to incandescence by the current from a Wallace-Farmer machine. Both the machine and the wire were furnished by Mr. Ladd, who has, we believe, joined a company for the supply of irridium. In a few moments after the machine was started the wire was lost in a rich mellow glow which illuminated the entire hall like evening sunlight. The golden effulgence excited the admiration of all, and many thought that it was no wonder Mr. Edison had been enthusiastic over such a light. The light is simply beautiful, but the cost is a different matter. One aim of Prof. Tyndall was to show how much the progress of electric lighting is due to Prof. Holmes, whom he called a "submerged inventor" for the reason that his work is so often lost sight of in these days; and he wound up his long lecture by an eloquent plea for the motives of inventors generally, and maintained that these men did not solely invent for the sake of gain, but often from the intellectual impulse of their genius. The mind of the inventor, he said, is like a vessel full of a saturated solution, which, when the proper fact is dropped into it, "becomes shot with the crystals of constructive thought."

SIEMENS' NEW ELECTRIC LAMP.—This novel lamp was first exhibited at the lecture above described. The improvement consists in dispensing with the negative carbon and substituting for it a hollow cone of copper kept cool by circulation of cold water within it. An examination of the voltaic arc shows that the light almost wholly emanates from the positive carbon, so that the negative need not be of this material. The copper is an excellent conductor, especially when kept cool, and it of course is permanent, so that the new lamp is an advantage in point of economy over the old Siemens' lamp. The principle involved in it of doing away with negative carbons is a new step likely to be of importance in electric lighting.

THE DYNAMO-ELECTRIC PRINCIPLE.—Touching the recent controversy as to whether Sir Charles Wheatstone, or Dr. Werner Siemens, or Mr. Varley priorly discovered this principle, Dr. Tyndall, in his lecture on the "Electric Light," laid down the law that the date of publicity must determine the priority, otherwise confusion would be the result.

ON January 4th, Professor Barrett delivered an interesting lecture on "Edison's Recent Discoveries," in the Hulme Town Hall, Manchester, in the course of which the carbon telephone was tried upon a line about a mile long, and persons at the further end of the line could hear the greater part of the lecture, although the speaker stood some ten or twelve feet from the carbon transmitter. Professor Barrett said that Mr. Edison's inventions were not merely clever contrivances, but generally contained some original observation in science which entitled him to the rank of a discoverer. In electric lighting, his discovery—and he (the lecturer) believed it to be such—enabled any one light to be raised or lowered at pleasure, without, in any way, interfering with other electric lights on the same main circuit."

IT is reported that Mr. Edison will soon visit this country.

LIVERPOOL AND THE ELECTRIC LIGHT.—At a special meeting of the Liverpool Town Council recently, it was resolved to obtain parliamentary powers for lighting the borough by electricity, and for purchasing the present gas company's works. A special envoy of the council reported on Mr. Edison's light which he had seen in America.

AMERICAN ELECTRIC LIGHTS.—A leading American electrician writes to us as follows:—"I know of no one here (whose opinion is worth anything) who has any confidence in the practical success of Edison's scheme. The way that the world stands agape waiting for the Edisonian mountain to bring forth its mouse is really absurd. I think you will be safe in not taking much stock of the greatly be-puffed electric light inventions of which the American newspapers are full. I have seen nothing yet as far advanced as what I saw at the Paris Exposition."

ON another page we give accounts of the electric candles of M. Rapieff and Mr. Wilde. Mr. Wilde found that to obtain a constant light from recent forms of the Jablochkoff candle, the alternating current supplied should in quantity and tension be such as to consume the candle at the rate of four or five inches per hour. If the current was too powerful the carbons were unduly heated and resisting; while if too weak, the arc flickered and was put out by air currents. Mr. Wilde also states that the plaster of Paris isolator did not always consume at the same rate as the carbons, and thereby obstructed the passage of the current, as was evident from the rosy tinge of the light produced by the volatilisation of the calcium simultaneously with the diminution of the brilliancy of the light from the carbons. Mr. Wilde, therefore, is of opinion that the isolator interferes with the regular consumption of the carbons under the alternating current. He suggests the employment of the carbon candle in the illumination of mines, by means of a powerful electro-magnetic induction machine, generating simultaneously alternating secondary currents in a number of small induction coils placed in various parts of the mine, the lights being enclosed in glass globes, having a small aperture to permit the egress of heated air, with wire gauze over it to prevent explosions.

PROF. MOSES G. FARMER, the well-known American electrician, now Professor of Electricity to the U.S.

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Navy, delivered an interesting lecture at Newport, R.I., on Dec. 23rd last. He recalled the fact that during the month of July, 1859, he lighted his parlour with the electric light from two small lamps fed by a battery. The light was discontinued because at that time it cost four times the amount of gas. Mr. Farmer considered a room very well lighted with one candle-light to every 75 cubic feet of space. As regards the electric lighting of New York, he assumed, as a basis, each person to have a 10-candle light. Taking the population at a million, there would be required a total of 10 million candle-light power. When subdivided, the electric light, he estimated, would only yield 500 candles per horse-power, and therefore 20,000 horse-power would be required to light the city. It would not be advisable, he said, to have dynamo-machines giving more than 5,000 candles each, for fear of them getting out of repair. Thus 2,000 machines would be required, and some 20,000 lamps. A new electrical corps would be necessary to superintend the lines and apparatus. If the light was only to be used during an hour or two out of the twenty-four, the cost of interest and depreciation of plant might exceed the cost of power consumed. In the course of his lecture Prof. Farmer ventured the opinion that "in five years from now there will be more gas consumed than there is to-day," judging from the stimulus which the electric light will give to improved gas lighting and heating.

As early as 1844, Dr. Draper used a strip of platinum, heated by the electric current, to determine the facts that all solid substances became incandescent at a temperature of 977° Fah., and that the light given out increases in refrangibility and intensity, the order of rays emitted being that of the prismatic spectrum, as the temperature rises. Dr. Draper also proposed a "unit lamp," which should consist of a strip of platinum one inch long by one-twentieth inch wide, connected to a lever by which its expansion might be measured. This lamp would yield at 2,000° Fah. a convenient unit light. It could be ingeniously kept at constant temperature irrespective of the source, and fractions of the luminous surface could be utilised instead of the whole. Mr. W. H. Preece has pointed this out in *Nature*.

THE steamers plying on the Weser and Elbe are to be fitted with electric lights. When will some of our London shipowners follow their example? How would an electric beam, shot through our smoky atmosphere vertically upwards, serve as a luminous signal for vessels in the Thames? With such a device, disasters such as that of the *Princess Alice* might be averted. In thick foggy nights or days, when the danger is greatest, the track of the light would be best seen.

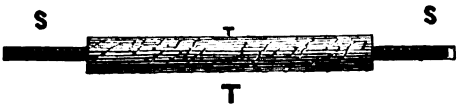
THE Marston Rock Salt Mine, Cheshire, has been lit by electricity, a Siemens' machine and Marshall engine being employed. The mine is several acres in area, the roof being stayed by pillars of salt. The lustrous effect of the light on the white sparkling salt is very fine. The arrangements were made by Messrs. Welch and Scott, Manchester.

THE Library of the British Museum is to be lit by electricity.

THE WALLACE-FARMER LIGHT.—The parallel arrangement of the carbons in this lamp were described and illustrated by a Mr. W. Gillespie in the *Mechanics' Magazine* for May 26, 1849. There is no account, however, of an automatic regulator for adjusting the distance of the carbons; this is merely done by a clamping screw.

STREET GAS-LIGHTING.—The competition of the electric light has at length stimulated the gas companies to supply better street lamps. The Chartered Company purpose replying to the Holborn Viaduct and Embankment electric lights by fitting Mr. Sugg's 200 candle burners to certain lamps in Waterloo-place. With these burners the jet is formed of concentric argand cylinders of flame, as many as five being used in the 500 candle burner, and the hot air ascends through a ventilator at the top, while the cold air descends from the top also, and is passed up between the flames. The lamp being closed at bottom, the flame is shielded from the wind, and hence is steady in the roughest weather. The lamp will be screened above by an opal reflector to throw down much of the light now lost in the sky, and no shadow will be lost by the lamp frame. These powerful gas lights are economical, for gas is said to yield a greater proportion of light per cubic foot as the quantity per hour is increased.

CLERAC'S TUBE.—This small instrument has acquired some historical importance in connection with the inventions of the microphone and carbon telephone, inasmuch as its use is based on the variable resistance of powdered carbon under pressure, a fact observed by M. Clerac, its inventor, as far back as 1865. Professor Hughes has had one of the earliest of these tubes—that illustrated below—in his possession since 1866



It consists, as shown in the figure, of a wooden tube, T, filled with powdered carbon, and having a brass rammer, S, at each end designed to screw in or out so as to compress the carbon to various degrees, and so modify its resistance. These screws also serve for terminals. A small touch-hole had been drilled by M. Clerac in the side of the tube to enable the operator to poke the carbon should it tend to cake inside; but Professor Hughes stopped it up with a tack to serve as an intermediate terminal. It is a very simple, even rude appliance, but it served its purpose admirably, and that was, to be a portable high resistance, variable at will within required limits. It was used by Professor Hughes in fitting his type-printer to different long lines in England and abroad, so that it has been carried about and shown by him in almost all the countries in Europe. Insignificant as it is, it contains the principle of the variation of the resistance of ground carbon under pressure, claimed for Mr. Edison as a novel discovery in 1873; but in 1866 there was apparently so little need of such an appliance, that Professor Hughes advised M. Clerac that the sale of these tubes would not recoup the expenses of a patent. To ensure the authorship of the invention to M. Clerac, however, a letter was written by Professor Hughes to him, acknowledging the receipt of the tube, above represented, and describing it. This letter was posted without an envelope in order that the postal stamp might certify its date. M. Clerac still possesses this letter. Clerac subsequently made many such tubes of glass, ebonite, and wood, with screws of different forms, some having probes to pierce the powder so as to loosen it when the probe was withdrawn. Through the courtesy of Professor Hughes, we have been enabled to test the Clerac tube, or variable carbon rheostat, in his possession, using both a galvanoscope and a speaking tele-

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phone as the test instruments, and we found that with the rheostat in circuit, the deflection of the needle in the one case and the intensity of the sound in the other *gradually* died away as the screw operated upon was eased outwards, that is as the pressure on the carbon in the tube was diminished. From some 5,000 ohms as its lower limit the resistance could be increased to infinity.

WHILE upon this subject we may call to mind the researches of M. du Moncel (published in 1855) upon the variation of contact resistances under pressure, and it is worthy of mention that Professor Hughes in 1867-8, found the metal contacts of the chariot of his type-printer so to vary with the pressure of the spring on them, that he had to adopt another plan. This fact was at that time well known.

THE TELEPHONE has been generally adopted in the Californian mines, some of which have lines 30 miles long. It is also employed in the great Comstock bullion mine.

THE TELEPHONE is to be employed by the divers of the New York Department of Docks, Edison's being the transmitter.

MR. W. CHANDLER ROBERTS, F.R.S., the pupil and successor of the late Professor Graham as Chemist to the Mint, delivered, on Jan. 22, the first of the series of triennial "Graham" lectures, inaugurated by the Glasgow Philosophical Society. His subject was "Molecular mobility, or some forms of invisible motion," and he illustrated the diffusion of gases by rendering the molecular impacts audible through means of a microphone.

THE PHONOGRAPH.—The Abbé Carbonel, of the Belsunce School, Marseilles, has been experimenting with the phonograph, and concludes that the recording and rehearsing diaphragms should be distinct, the former having a very sonorous plate operating on very stiff, hard foil, the latter a delicate membrane like that of the ear. The foil could be made from a copper band thinly coated with wax to take the impression, and corroded afterwards by acid so as to obtain a hard metal cast; but this is necessarily a defective process. The Abbé therefore employs albumen spread upon paper or other base, instead of the wax applied to the copper. The soft albumen record is afterwards hardened in a well-known manner, and a hard matrix, whose dints vary in depth with the intensity of the sound, is obtained. As a means of reproducing the sounds he suggests the use of Savart's wheel instead of a vibrating plate.

THE Central American republics of Costa Rica, Nicaragua, Guatemala, and Honduras, from San Juan del Sur to Mexico, have been put into telegraphic communication with each other by completion of the section of line between Chichigalpa, Nicaragua, and the boundary line of Honduras.

THE 1879 Session of the Society of Telegraph Engineers was opened on January 22, by the address of the president, Major Bateman-Champain, R.E. Among the papers proposed to be read during the term are the following:—"On the working of long submarine cables," by Willoughby Smith; "A new determination of the ratio of the electro-magnetic to the electrostatic unit of electric quantity," by Professors Ayrton and Perry; "On curbed signals for long cables," by James Greaves; "On the establishment of relay stations for the purpose of expediting telegraphy," by W. H. Preece; on "Electric intercommunication on railway trains," by C. V. Walker, F.R.S.; on the "Electric light; its past, present, and future," by Lieut.-Col. Bolton and W. H. Preece; "On the soaking out of the residual charge in a Leyden jar," by Professors Ayrton and Perry; and on "Colonial telegraphs," by J. Sievewright, M.A. We understand that Professor Hughes will also read a paper dealing with the induction on telegraph lines.

POSTAL OFFICIALS AND LITERATURE.—About two years ago the Post-office and telegraph officials belonging to the East London District, instituted a Circulating Library and Literary Institute. This has been found a boon to this numerous class, who, unable to pay for standard works of literature, not being within the area of any good circulating library, and comprehending a large proportion of young persons with small salaries, are now, at an outlay of a halfpenny a week for telegraph messengers and a penny for letter-carriers and others, supplied with the best literature existing, including the chief periodicals that are issued. The boy telegraph messengers alone in the district read 1,440 volumes, besides numerous magazines, during the seven months ended November last, a very encouraging fact when it is to be remembered how such lads as these are catered for by the publishers of boys' literature. The institute feels the want of such articles as wall maps and pictorial illustrations of the arts and sciences. The committee are extending their operations in the establishment of a mutual improvement society, with lectures and classes, and as the subscriptions will scarcely meet the necessary expenses they make a modest appeal to the public for assistance. Presents of books and pecuniary aid will be thankfully received by the secretary, Mr. F. H. Parsons, at the District Office, Commercial-road, E.

MUIRHEAD AND WINTER'S QUADRUPLEX.—This novel system of quadruplex is working very successfully on the trans-Indian line, between Madras and Bombay. It is a split battery system, and promises to be superior to Edison and Prescott's. We are obliged to reserve a full account of it until the patents are secured, but will do so then. The advantages claimed for it are (1) that considerable change in the resistance of the line do not disturb the balance; (2) that the receiving instruments do not require to be differentially wound, and (3) that there is no loss of current-power from the use of a Wheatstone Bridge.

City Notes.

Old Broad Street, Jan. 29, 1879.

THE directors of the Anglo-American Telegraph Company (Limited) have resolved (after placing £37,500 to the credit of the Renewal Fund) to recommend to the proprietors of the next half-yearly general meeting of the company, to be held on the 7th February next, the declaration of the following dividends, all free of income tax:—1. A balance dividend of 1½ per cent. upon the ordinary Consolidated Stock, for the half year ended Dec. 31, 1878. 2. A first and final dividend of 3 per cent. on the Deferred Stock for the year ended Dec. 31, 1878. After paying the foregoing dividends there will be a balance of about £3,587, to be carried forward to the next

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account. The above dividend, together with those already paid, amount to 4½ per cent. upon the ordinary Consolidated Stock of the company for the year 1878.

The directors of the Direct United States Cable Company have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum, for the quarter ending 31st December 1878, such dividend to be payable on and after the 15th February.

The report of the directors of the Eastern Telegraph Company, to be presented to the Thirteenth Ordinary General Meeting, 30th January, 1879, shows the Company's revenue for the six months ended 30th September, 1878, amounted to £207,347 19s. 6d., from which is deducted £56,339 17s. 3d. for the ordinary expenses of the Company, and £20,154 3s. 3d. for special expenditure during the half year, as shown in the annexed accounts, which, with £2,726 2s. 6d. for income-tax, leaves the sum of £128,127 16s. 6d. net profit. From this amount, £32,269 13s. 2d. the interest on debentures and the dividend on the Six per Cent. Preference Shares to 30th September, together with two interim dividends on the ordinary shares for the quarters ending 30th June and 30th September, 1878, amounting together to £92,425, have been paid, leaving a balance of £3,433 3s. 4d. to be carried forward. The several sections of the Company's cables remain in good working order, with the exception of the Lisbon Cable, which is now under repair. The Company's cable repairing ships, stationed in the Mediterranean and the Red Sea, are in efficient condition, and in readiness for the Company's requirements. The Joint Purse Agreement between the Indo-European Telegraph Department of H.M. Indian Government, the Indo-European Telegraph Company, and this Company, continues to work satisfactorily. By the resolution of the Extraordinary General Meeting of Shareholders, held on 9th August last, the directors were empowered to acquire the shares and undertaking of the Black Sea Telegraph Company (Limited), and to raise capital for the purpose; and for the laying of a new cable between Alexandria and the Island of Cyprus. The transfer of the shares of the Black Sea Telegraph Company has been completed, and the cable (from Constantinople to Odessa) is now worked as part of this Company's system. In accordance with arrangements made with H.M. Government the Company has connected Cyprus with Alexandria by cable, and is now constructing land lines in the island. The capital required for the new works has been raised by an issue of five per cent. debentures, payable 1st August, 1887, of which £181,900 has been issued to the shareholders up to this date. Two of the directors, the Marquis of Tweeddale (Lord W. M. Hay, M.P.) and the Right Hon. W. N. Massey, M.P., retire by rotation, and being eligible, offer themselves for re-election.

The report of the directors of the Western and Brazilian Telegraph Company, to be presented at the sixth ordinary general meeting, 31st January, 1879, states the total earnings of the year amounted to £92,882 1s.; the working expenses (including £1,737 3s. 3d. rebate on issue of A, B, and C debentures) charged to revenue were £72,552 4s. 2d., which, together with £17,066 7s. 8d. interest for the year on the A, B, and C debentures, gives a total of £89,618 11s. 10d., leaving a net balance of £3,263 9s. 2d. to the credit of revenue account. It goes on to say:—"The ordinary working expenses show a reduction as compared with last year. The expenditure on account of maintenance and renewals exhibits on the other hand a very considerable increase. The revenue shows a falling off compared with the previous year, of £5,652 15s. 11d. The general stagnation in commercial affairs will in part account for this, and the numerous interruptions of the company's cables have also influenced the revenue. The revenue account is subject to the settlement of the question raised by the Brazilian Submarine Company as to whether, in consequence of the lengthened interruption of the Pará-Pernambuco section, this company should participate to the extent of one-third in their gross receipts, as provided by the agreement existing between the two companies. It has therefore been necessary to estimate the amount due under this agreement. The expenditure on maintenance and renewal account this year charged against revenue has been £38,194 6s. 10d. The repairs and the extensive renewals effected have involved an expenditure of £69,194 6s. 10d., of which £38,194 6s. 10d. has been directly charged to revenue, and £31,000 to renewal account. The directors regret that so small a net revenue has been earned; a very great permanent improvement has been effected in the lines by the substitution of sheathed cable for that originally laid down; and although more work in the same direction still remains to be done, your cables are more secure and are working better, with greatly improved chances of unbroken communication. The directors commenced proceedings against Mr. Heugh, the late chairman of the company, for sums of money which the Board are advised he is accountable for, and these proceedings are being continued under the bankruptcy."

The Globe Telegraph and Trust Company (Limited) announce the payment, on and after February 7, of interim dividends for the quarter ending 18th January of 3s. per share on the Preference Shares, being at the rate of 6 per cent. per annum, and 2s. per share on the Ordinary Shares, being at the rate of 4 per cent. per annum.

The Eastern Extension Telegraph Company have given notice that the half-yearly coupons on their Six per Cent. Debentures, due on the 1st proximo, will be payable on and after that date, at the Consolidated Bank.

On Jan. 24th the Indo-European Telegraph Company notified that "The Black Sea direct cable from Odessa to Constantinople being restored, communication is now re-established by the special Indo-European route to Turkey."

The managing director of the Brazilian Submarine Telegraph Company (Limited) states that their cable to Madeira is working perfectly, and that there is no interruption either on the lines or cables of the Eastern Telegraph Company between London and their terminus at Lisbon.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 58½-59; Ditto, Preferred, 84-85; Ditto, Deferred, 33-34; Black Sea, Limited, —; Brazilian Submarine, Limited, 6½-6¾; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 15¼-15¾; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 9¾-10¼; Direct United States Cable, Limited, 1877, 11¼-11½; Eastern, Limited, 7-7¼; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1887, 102-105; Eastern, 6 per cent. Preference, 11-11¼; Eastern Extension, Australasian and China Limited, 7-7¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 5-5¼; Globe, 6 per cent. Preference, 10⅜-10⅝; Great Northern, 7⅛-8⅛; Indo-European, Limited, 19-20; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 10-11; Submarine, 217-222; Submarine Scrip, 2-2¼; West India and Panama, Limited, 1¾-2⅛; Ditto, 6 per cent. First Preference, 8-8½; Ditto, ditto, Second Preference, 7½-8; Western and Brazilian, Limited, 2½-3; Ditto, 6 per cent. Debentures "A," 88-90, Ditto, ditto, ditto, "B," 85-89; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 30-31; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2¼-2¾; India Rubber Co., 9¼-9½.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 145.

THE ELECTRIC LIGHT IN ECLIPSE.

THE electric light, after an unprecedented outburst during the latter part of last year, has of late begun to wane in public interest. The inevitable reaction has set in, and even its former admirers are turning a severe eye upon it. We are told that its violet rays give the countenance a cadaverous hue, that it vitiates the air not only with ozone (which is a wholesome thing by the way), but with carbonic and nitric acids, and that white hot sparks fly from it with dangerous impetus. The impossibility of subdividing it has been drummed into our ears until it has become that most pernicious of all kinds of cant, namely, scientific cant; and the hopeless cost of producing it has been harped upon incessantly.

The fact that Mr. Edison has neither given the public exhibition of his light, which was promised, nor authorised accounts of it as yet; and the failure of the Jablochkoff system at Billingsgate Market and Westgate-on-Sea, are, perhaps, the leading causes of this reaction. Some people have begun to think that Edison is finding out that he cannot perform what he undertook; but the wiser plan is at least to wait until his method is fully disclosed. The Jablochkoff system has been fairly tried on its own merits at Westgate-on-Sea, at the instance of Mr. E. F. Davis, a landowner of that place, and pronounced a failure in point of cost as compared with gas. Six Jablochkoff lamps were fitted up in the Sea Road, 80 feet apart, each containing four candles which burned an hour each. The current was supplied by a six light Gramme machine, driven by a 10 H.P. (nominal) portable engine, made by Messrs. Garrett & Co. The current was divided into two circuits, each of which included three lamps. One attendant was required for the engine and one for the machine and lamps. The experiments began on Dec. 2nd, and were kept up for 24 nights for four hours each night, thus giving a total of 96 hours. On eight several occasions candles went out, perhaps because of the carbons being faulty; and each time this took place both the others in the same circuit were extinguished. The working expenses for 24 days amounted to £40 9s. 4d., and this sum includes fuel, water, oil, 586 candles at 8d. each, and the wages of the two attendants. Each lamp gave a light equal to 197 sperm candles, and therefore the illuminating power of the whole six came to 1,182 candles. To produce the same amount of light by Westgate gas 107½ gas jets, burning 5 c. ft. per hour, which at the Westgate rate of 6s. 6d. per 1000 c. ft. would cost in all £16 15s. 4d. for the 96 hours. Calculated at the London price of 3s. 6d. per 1000 c. ft., the total cost would only have been £7 18s. 9d. for gas, as against the £40 9s. 4d. for electricity. On this basis the working expenses of the six electric lights for a year of 4,327 lighting hours, is given by Messrs. Bennet and Valon, the engineers, as £1,576 0s. 8d., or about 1s. 2½d. per light per hour, including the interest at 10 per cent on the first outlay, for buildings, plant, &c., which is put down at £1,522. This estimate is exclusive of interest on working capital, and depreciation of buildings and cables. The cost of supplying Westgate with gas for the same time, including lighting, cleaning, and repairing would only be £825 14s. 10d. For London it would be very much less, only £427 13s. 3d. for gas, as against £1,576 0s. 8d. We thus gather from the very valuable and expensive experiment of Mr. Davis, and the clear report of his engineers, that the Jablochkoff system is between three and four times more expensive than London gas lighting.

Luckily, however, the fate of electric lighting does not rest upon the Jablochkoff system, although the failure of the latter will for a time throw discredit on all other plans. Jablochkoff's system is known to be at least twice as expensive as other systems now in vogue, and far more complicated. If it is found wanting, other plans must be tried instead, before the question of gas *versus* electricity can be fairly settled as it stands. The electric light has a double field. It can compete with gas in the lighting of streets and open spaces, and it can be used for special purposes which gas is unsuited to. For the former places the relative costs will determine whether it will be preferred to gas or not; for the latter places its introduction is assured irrespective of the cost of gas, for no light can vie with it for the purposes in view. Now as regards open spaces where a few large lights are used, it is well to bear in mind that Mr. Schwendler finds the electric light from a single Serrin source to be 50 times cheaper than gaslight, a figure which allows a wide margin for loss by subdivision for street lighting.

The amount of contradictory assertions made as regards the science of the electric light serve to show that it is dangerous to dogmatise as yet upon the subject. Even the electric properties of the arc are not yet fully understood, and still less are its photometric properties. It is ever the case that those who lack the necessary inspiration to conquer

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a difficulty, are the first to preach its impossibility. Prof. Ayrton has shown that the difficulty of subdividing the electric light is not an electrical one but is due to the fact that the amount of light produced is not directly proportional to the amount of heat produced. What then if a means be found of making the light proportional to the heat produced? Again, Mr. W. H. Preece has shewn [see page 59.] that with incandescent iridium, a temperature can be reached at which the light given out is equal to that from the voltaic arc itself. Iridium is very costly now, but if there be a demand for it, will it not soon be cheapened? Dynamo-electric machines are undergoing constant improvement. Carbon-electrodes are recognised as defective and will either be speedily bettered or abandoned altogether. Many minds are concentrated on the problem of electric lighting, and the prizes are great. So that it would be unwise to assume that the eclipse which the electric light is now suffering will be a lasting one.

A TELEGRAPH TO THE CAPE.

THE recent disaster to our arms inflicted by the Zulus renders it imperative that telegraphic communication should be speedily established with the Cape Colonies. The subject was brought to the notice of Sir Michael Hicks-Beach on February 12 by a deputation, headed by Sir J. Lubbock and Sir H. Barkly. These gentlemen advocated the construction of an overland line from Egypt to Pretoria *via* Zanzibar, the pet scheme of the colonists, and requested a Government subsidy to aid in the work, which they estimated to cost £750,000. The Colonial Secretary replied that the Government was prepared, with the Colonial Parliament, to subsidise a company undertaking the work; and that he believed at present a cable more feasible than a land-line, though the latter might be more advantageous when once established. Before deciding in the matter he should, however, require a definite estimate of the time and money required for making a land-line. It is to be hoped that this will speedily be furnished him, and that, whether the line be overland or submarine, and the latter indeed seems to us the most feasible at this time, it will now be realised.

BRIGHT'S ELECTRICAL FIRE INDICATOR.

THE electrical fire alarm systems so common in American towns, have never been received with much favour in England. Whether this arises from mere apathy or from the conservatism, for which Local Government Boards are notorious, it is difficult to say, but the fact remains that although many attempts have been made, but very little, if any, progress has resulted towards introducing any system of electrical or other fire alarms. It is not that such systems have not been shown to be practicable, for many have been exhibited and partially worked with success, but unfortunately, we believe, in no case, where the apparatus has been fitted, has an opportunity arisen for practically demonstrating the utility of the inventions, and for this reason possibly the schemes have been allowed to fall into oblivion.

One of the most recent inventions for effecting the object in view, is that of Mr. E. B. Bright, whose system has recently been fitted up, and had a practical trial, in Glasgow. As this system possesses some decided points of novelty over those hitherto invented, it merits a description.

The chief point of novelty in the apparatus consists in the employment of artificial electrical measures of resistance (or rheostats) for the purpose of making known the locality of the fire; such artificial measures of electrical resistance being used in combination with thermostats or appliances for closing or opening or making a variation in an electrical circuit or circuits by such fire.

The following is a description of the apparatus:—

Fig. 1 is a section, and fig. 2 a side view of a thermostat, consisting of a metallic box inside of which is fixed a curved band *c*, formed of two metals, such as platinum and brass, which expand unequally under the influence of heat. Opposite the end of the band *c*, is an insulated screw *d*, which can be so adjusted that the addition of any given amount of heat will, by its effect upon the band, bring the end of the band *c* into contact with the end of the screw terminal *d*. The terminal *e* is connected with the metallic box, and therefore with the curved band *c*.

Fig. 3 is a general plan, shewing the apparatus employed at the fire brigade station or other place to which a warning is to be given, and also a diagram of the electrical circuits in connection with the thermostats and rheostats by which the locality whence the warning proceeds is indicated.

Fig. 4 is a side view of the indicating apparatus at the fire brigade station or other place to which a warning is to be given.

The series of circles marked with numbers varying from 5 to 15 included by the bracket *f*, represents a number of rheostats placed in the various buildings or places from which an alarm may be given. They are connected together by a line wire *g*, extending to the fire brigade station, as shewn by the diagram, which wire is there joined to one side of the differential coil *h*, and thence through the alarum *i* to one pole of the battery *j*. The same pole of the battery *j* is also connected through the alarum to the other side of the differential coil *h*, and thence to the end of a series of rheostats fixed round a circle in the indicating apparatus at the station, which are also marked on the plan, with numbers varying from 5 to 15, indicating electrical resistances corresponding with those of the rheostats included in the bracket *f*, before described.

By means of the handle *k* the arm *l* with a spring *m* can be moved over a series of metallic plates *n*, *n*,

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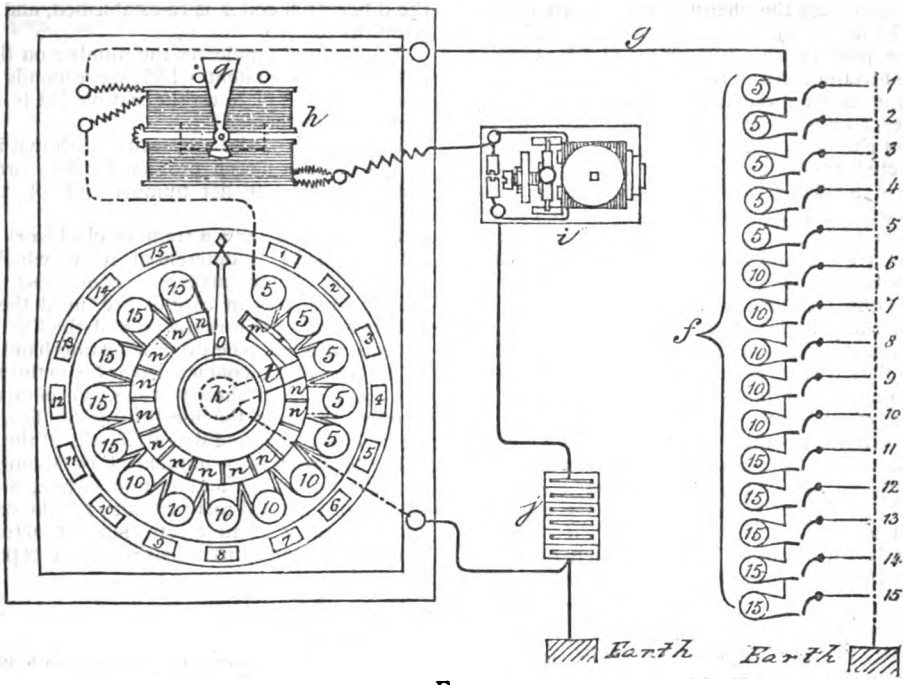
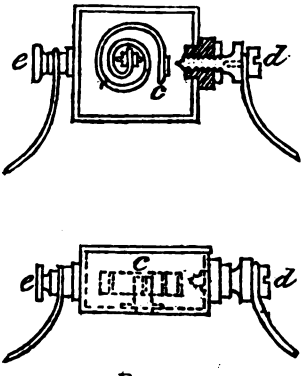


FIG. 3.

FIG. 1.



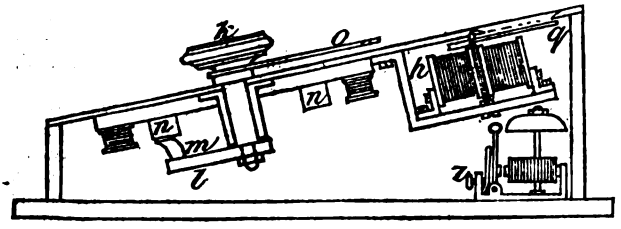


Fig. 4.

FIG. 2.

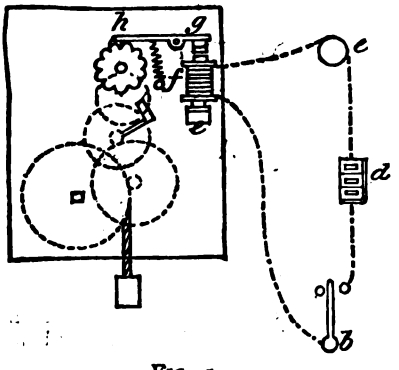


FIG. 5.

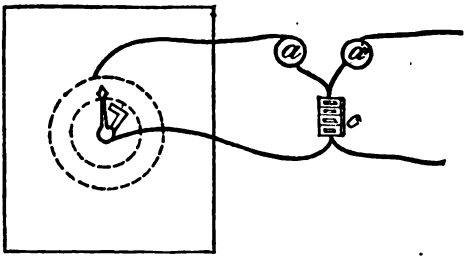


FIG. 6.

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which are insulated from each other, and connected consecutively with the rheostats, as shown on the plan. The arm *l* and spring *m* are connected with the other pole of the battery *j*, which is also connected to the earth. To the handle *k* is attached a pointer *o*, moving outside the dial of the instrument over a circle of figures corresponding to the number of rheostats in the circuit.

Connected to one end of each of the rheostats included in bracket *f*, is a thermostat, the insulated screw of which *d* (figs. 1 and 2), is connected to the earth. On an undue increase of heat taking place, the band *c* (figs. 1 and 2) of the thermostat makes contact with the insulated screw *d* (figs. 1 and 2), and thus completes the circuit with the battery *j*, as shewn by the dotted line *p*.

The electric current from the battery *j* passing thus through the alarum *i* rings it, and also passing through one side of the differential coil *h*, deflects the disc *q*, which is fixed to the axle of a permanent magnet contained within the coil *h*. On the alarm being thus given, the person summoned moves the handle *k* round the dial of the instrument, and as soon as the spring *m* comes into contact with the particular plate *n* connected with the rheostat that corresponds with the line rheostat which has been put to earth by the thermostat at the point from which the alarm is given, the electrical balance of the differential coil *h* is re-established, and the disc *q* returns to zero.

The pointer *o* indicates the number on the dial of the station instrument which corresponds with the number of the place on the station list from which the alarm emanates.

In the plan of the apparatus, as drawn in figs. 3, 4, and 5, only fifteen protected places are shewn, but a larger or smaller number can, of course, be connected.

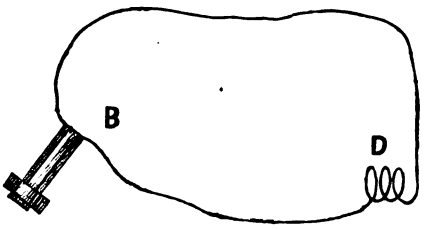
Figs. 5 and 6 shew a train of clockwork brought into action by a differential relay, which moves round the contact maker in connection with the station rheostats in case of fire, until the balance between the station rheostats and the line rheostats is re-established, when the indicating hand attached to the axle of the contact maker (as in the apparatus worked by hand shown at fig. 3) points to the number showing the locality of the fire. In this figure *a*, a^1, are the differential coils of the relay; *b* is the contact maker influenced by them; *c* is the battery of the line and station circuit, and *d* the battery of the local relay circuit; *e* is the coil of the alarum, and *f* is an electro-magnet actuating an armature *g*, and thus releasing the escapement or detent h^1.

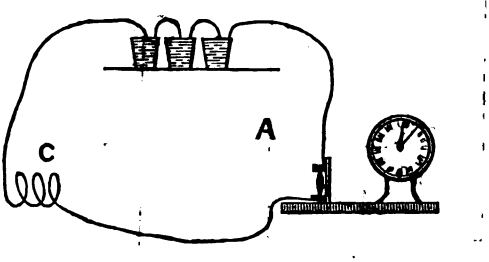
EXPERIMENTAL INVESTIGATION BY AID OF THE TELEPHONE AND MICROPHONE.

By PROF. D. E. HUGHES.

INDUCTION BY VOLTAIC CURRENTS.—It is well known how remarkably sensitive the telephone is to induced currents. They were remarked at once upon all the telegraph lines, and have in a great measure prevented its use upon lines which contained several other wires worked by the Morse or other telegraph systems. The microphone greatly aids us in researches of this nature, and we will cite a few experiments which are interesting, both from a scientific and practical point of view.

The arrangement of the circuits were as follows: The sounds of the clock being transmitted by the microphone to a coil of wire, and, from a separate coil superposed or near this primary coil, conveyed to an ordinary telephone upon which the results were observed. Thus—





A Microphonic circuit.
B Telephonic circuit.
C Primary coil.
D Secondary coil yielding induced currents which were listened to in the telephone B.

I.—Two similar coils, of 60 turns, No. 30 covered copper wire, and 2 inches diameter, the one being used at C for primary, the second at D for secondary. Sounds and speech could be clearly heard in the telephone with a perfection of timbre very remarkable. If the coils were near each other, the sounds were nearly as loud as if the telephone had been in primary circuit; on gradually removing it, although the sounds gradually diminished, they could be clearly heard 12 inches apart. In moving the secondary coil D round C, there was no position either in a line or otherwise, in which the sounds could not be clearly heard, and that at really surprising distances, except when they were exactly at right angles, when there was absolute silence.

II.—But little difference could be observed in the induced currents if a magnet was placed in the coil C or D, but they were stronger if the same magnet was placed in the centre of both coils. A bar of iron two feet long increased the force when placed in coil C, and if both coils were placed around the middle of this bar, 10 inches or more projecting on each side, the maximum results were obtained, they being far superior to those from the permanent magnet; thus with induced currents a constant magnetic field induced by a natural magnet plays but little part;

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the electro-magnetic changes taking place in a bar of iron have important and easily recognisable effects.

III.—The coils C and D being held firmly on stands at a fixed distance of 4 inches. No appreciable difference could be observed by the interposition of any non-conductor, such as wood, guttapercha, &c.; but of conductors there was a difference, copper being the most marked, equal to six plates of iron of same dimensions; but it was remarkable how little difference this made, for, with fifteen interposed sheets of iron, the sound still had about one-quarter of its original force, and when we remember that on each of these plates strong induced currents were produced, it was remarkable that there should still have remained a surplus force to produce the clear and distinct tones by the induced currents produced after all this work.

IV.—Coils being as above, but 5 inches apart, so as to allow of the introduction between them of a half-pound reel of No. 30 covered copper wire, and ends of this wire left open, no appreciable diminution of sound was remarked; but the instant the circuit was closed by joining the two ends of the half-pound reel the sounds were diminished so as to be hardly audible: the telephone here verifying a fact long well known of the influence of closed circuits in cutting off the induced currents; but that the effect is in all cases proved to be but partial was by the introduction of one or two coils similar to C and D between them having closed circuits. The screening effect of these coils was hardly perceptible.

V.—Four coils were constructed all of exactly similar wire and length. Two were of a flat wide surface, 3 inches diameter, ½ inch high. The other two were formed after the ordinary helix pattern of an electro-magnet, 1 inch diameter, 2 inches high. It was found that the flat coils (used by Henry, Hare, and Matteuci for induced currents) were far more powerful than the two ordinary helices placed at any distance from each other; the flat coils were fully three times more powerful. One of these electro-magnetic helices was then unwound and rewound over the second, similar to the arrangement in the Ruhmkorff coil, and compared with the flat coils resting on each other, the winding of the coil *à la Ruhmkorff*, had decidedly improved their force, but still the flat coils showed a marked superiority, being about one-half stronger, as near as it was possible to judge from estimation by sound.

VI.—If we change the conditions of the last Experiment, and replace the coil C by an ordinary telephone, placing the coil D below the diaphragm, so that its ordinary coil will be in the centre of this coil, we shall then hear loud tones in both telephones, the first in the primary, the second in the secondary, or induced circuit, and very little difference will be perceived between them. By this system, a double telephone can be used, giving double the effect of a single one, and that without introducing more resistance in the primary circuit than a single telephone, a very remarkable advantage where two telephones are used, and what is still more remarkable is, that if we withdraw the magnet and coil of the primary circuit, so that it is no longer in perfect adjustment, giving feeble tones, the second telephone worked by the secondary coil stationary near diaphragm, gives out almost as loud tones as originally, thus the secondary circuit then becomes far the loudest and clearest.

VII.—We have already shown that we can, by the induction of one coil near the other, hear distinctly all the sounds of the microphonic circuit. If now, instead of using one primary coil and one microphonic circuit, we use two or more distinct primary circuits, each connected with its special microphone, and these primary coils placed near one another, the single secondary coil placed at a distance intermediary from these separate primary coils; we hear then in the telephone not only the clock of the first primary, but in addition, say, articulate sounds on second primary, and singing or music on third. We have here a compound induction of three distinct undulatory waves of primary resolved into one undulatory wave, giving us at the same time the effect of the whole. We might thus have a piano in one room, singing without words in another, and words only in the third, and these, not in any way directly connected to telephone line, would by simple induction give us the effect of a song with words and piano accompaniment.

VIII.—Having seen by numerous experiments that the induced currents act at great distances, we thought that by simply placing a diaphragm in a high magnetic field we should hear distinctly from the diaphragm, notwithstanding that the coil was separated several inches from it. To this end we took out the coil of an ordinary telephone, leaving simply the magnet and diaphragm. The magnet was carefully adjusted near diaphragm, and the coil C of the microphone circuit held near this skeleton telephone. Loud sounds could be clearly heard when coil near telephone, no matter in what position or direction; the coil might be held several inches distant, and still the sounds were audible. If we withdrew the magnet no sounds were audible, however near the coil might be; but on re-adjusting magnet, by careful listening, the sounds could be heard when coil was 12 inches distant, and on placing the skeleton telephone to one ear and the coil to the other, clear sounds could be heard. On removing the telephone, which was not in any circuit, and listening to the coil which was, and from which the force proceeded, no sounds whatever could be heard. On replacing the telephone, the clear and comparatively loud tones at once became audible. Thus the electro-magnetic induction passed through one ear unperceived to put the diaphragm beside the second telephone in motion, by means of which sonorous waves were at once produced which that ear could appreciate.

THE CRITERIA OF THE ELECTRIC LIGHT.

We extract the following passages from a very instructive lecture to the Royal United Service Institution, by Mr. W. H. Preece:—

Heat and light are identical in character, though different in degree; and whenever solid matter has imparted to it motion of a very high intensity—in other words, when solid matter is raised to a very high temperature—it becomes luminous. The amount of light is dependent upon the height of this temperature; and it is a very remarkable fact that all solid bodies becomes self-luminous at the same temperature.

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This was determined by Daniell to be 980°, by Wedgewood 947°, by Draper 977°; so that we may approximately assume the temperature at which bodies begin to show a dull light to be 1,000°. The intensity of light, however, increases in a greater ratio than the temperature. For instance, platinum at 2,600° emits forty times more light than at 1,900°. Bodies when raised to incandescence pass through all stages of the spectrum; as the temperature increases, so does the refrangibility of the rays of light. Thus, when a body is at a temperature of—

Temperature °	
250	it may be called warm.
500	,, ,, hot.
1,000	we have the red rays,
1,200	,, ,, orange rays.
1,300	,, ,, yellow rays.
1,500	,, ,, blue rays.
1,700	,, ,, indigo rays.
2,000	,, ,, violet rays.

So that any body raised to a temperature above 2,000° will give us all the rays of the sun. Inversely, the spectroscope may thus be enabled to tell us the temperature of the different lights, and it is, perhaps, because some lights do not exceed 1,300° that we lose all those rays beyond the yellow. . . .

Dr. Tyndall has shown that the visible rays of an incandescent wire bear to the invisible rays a much smaller proportion than in the arc, and it is generally assumed that for the same current the arc will give at least 2½ times greater light than an incandescent wire; in fact, Dr. Tyndall's figures are as follows:—

	Visible rays.		Invisible rays.
Gas	1	to	24
Incandescent wire	1	,,	23
The arc	1	,,	9

* * *

The requirements of a good electric lamp are, first, intense brilliancy; secondly, great steadiness; thirdly, duration. The Serrin lamp has the first kind of excellence; all those lamps based on incandescence excel in the second respect: the Wallace-Farmer light is the only one that attains the third point. The Rapieff is perhaps that form which up to the present most nearly combines the three requisites, but in reality no lamp has yet been introduced which fulfils all three requirements.

The objections to the use of the electric light are:—

1. The deep shadows it throws.

2. The indifferent carbon that has hitherto been manufactured for the purpose, which leads to unpleasant sounds, to great variation in the intensity of the light, and to waste.

3. The difficulty in distributing the light itself. It is so intense and confined to so small a space that it does not lend itself to distribution like the gas flame which occupies a considerable space.

4. The unsteadiness of the light due to variations in the speed of the engine employed in driving the dynamo machine. There is another cause of variation in the electric arc, and that is, the variation in the resistance of the arc itself, for it has been clearly demonstrated by experiments both in America and in England, that the resistance of the arc varies as the resistances in circuit vary. The following table will show this:—

Current in Webers.	Light candles.	Resistance of arc. Ohms.
10	440	2·77
16·5	705	1·25
21·5	900	1·67
30·12	1230	·54

The light in the arc varies directly as the current, and not as the square of the current as is generally assumed.

Now, in the case of light raised by incandescence, the light will increase as the square of the current. It follows that if in the one case—viz., the arc, the light increases as the current only, and in the other case—viz., incandescence, it increases as the square of the current, a point is reached when the light produced by incandescence will equal that produced by the arc. The difficulty in reaching that point is the difficulty in obtaining a conductor with a sufficiently high point of fusion to resist the effect of powerful currents. Iridium is the only metal that is known to do this, and iridium is too scarce and too dear to be used for the purpose.

The multiplication of the light by Gramme's machine upon the Thames Embankment must not be taken as the solution of the problem of the subdivision of the light. Theory shows unmistakably that to produce the greatest effect we must have only one machine to produce only one light. We know from absolute measurements that such a machine can be used to produce a light of 14,880 candles, and it is possible to produce 1,254 candles per horse-power. But the moment that we attempt to multiply the number of lights in circuit this power diminishes, so that we have on the Embankment lamps giving us a light of scarcely more than 100 candles. The light of the Rapieff lamp in the *Times* office appears to be about 600 candle power, and the Wallace light is equal to 800 candle power. In these two instances six lights are used in one circuit, but we have not here the subdivision of the light, we have, on the contrary, the multiplication of the light, produced by the increased speed of the engine due to the insertion of additional lamps. It is, however, easily shown that in a circuit where the electro-motive force is constant, and we insert additional lamps, then when these lamps are joined up in one circuit, *i.e.*, in series, the light varies inversely as the square of the number of lamps in circuit, and when joined up, as in multiple arc the light diminishes as the cube of the number inserted. Hence the subdivision of the light is an absolute *ignis fatuus*. In the first place no machine has yet been produced which is competent or capable of lighting over 20 lamps; secondly, no conductor is known but copper competent to convey the current required to light these lamps, and copper is an expensive material. Thirdly, no electric light has yet been produced which combines all the criteria needed for a good light.

RAPIEFF'S THREE-CARBON NEW REGULATOR LAMP.

SINCE the Rapieff's four-carbon regulator electric lamp was described in THE TELEGRAPHIC JOURNAL for November 1st, 1878, M. Rapieff has made some important improvements in his ingenious apparatus. He has constructed a new three-carbon regulator lamp, designed for lighting up the machine and composing rooms of the *Times* office.

An objectionable feature in all electric lamps, and especially "candles," now in use, is that the bottom part of those apparatus containing the mechanism of the regulator or the holders for the "candle" is opaque, and being also brought into such close proximity with the voltaic arc, absorbs a great portion of the light immediately below the apparatus, that is, just where the light is most needed. In this respect the electric light has hitherto been very

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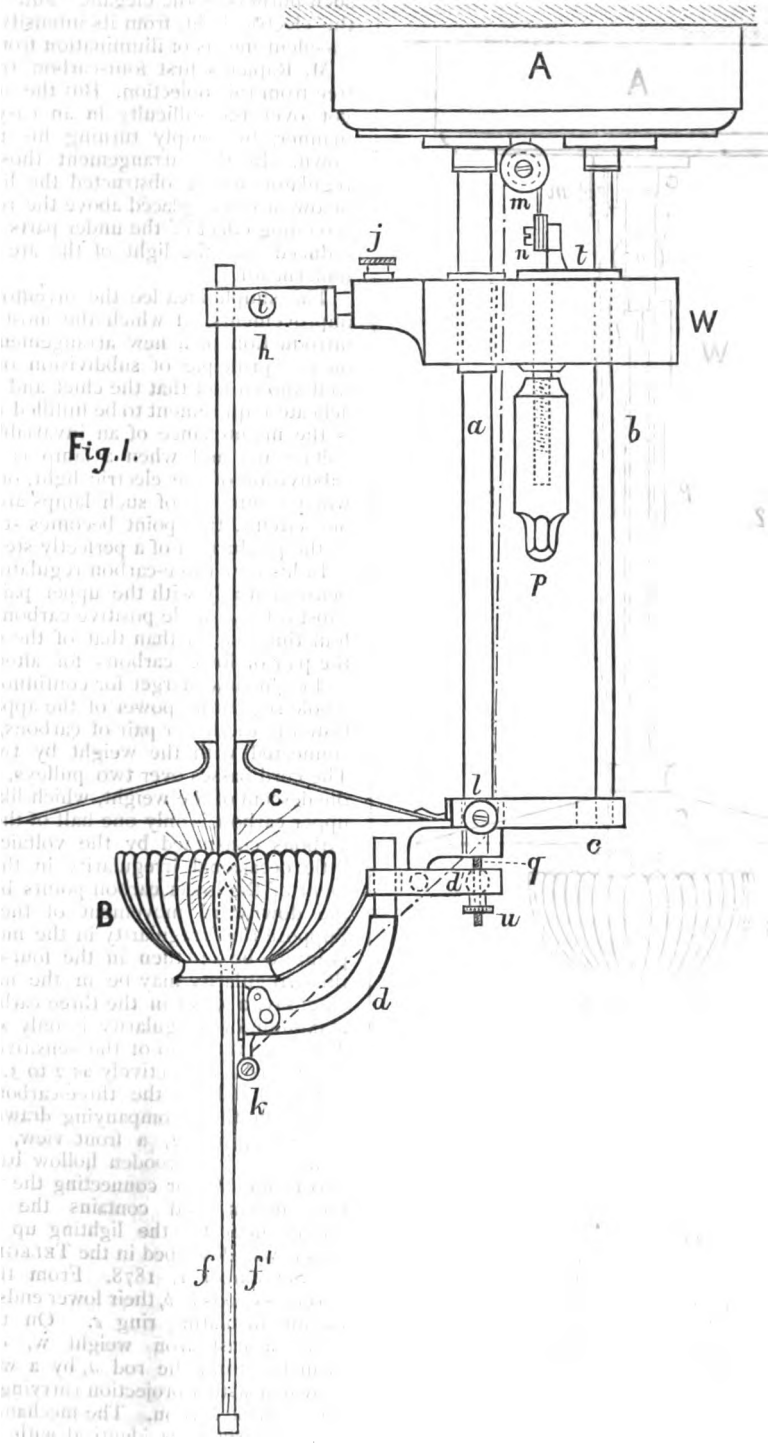

Fig. 1.

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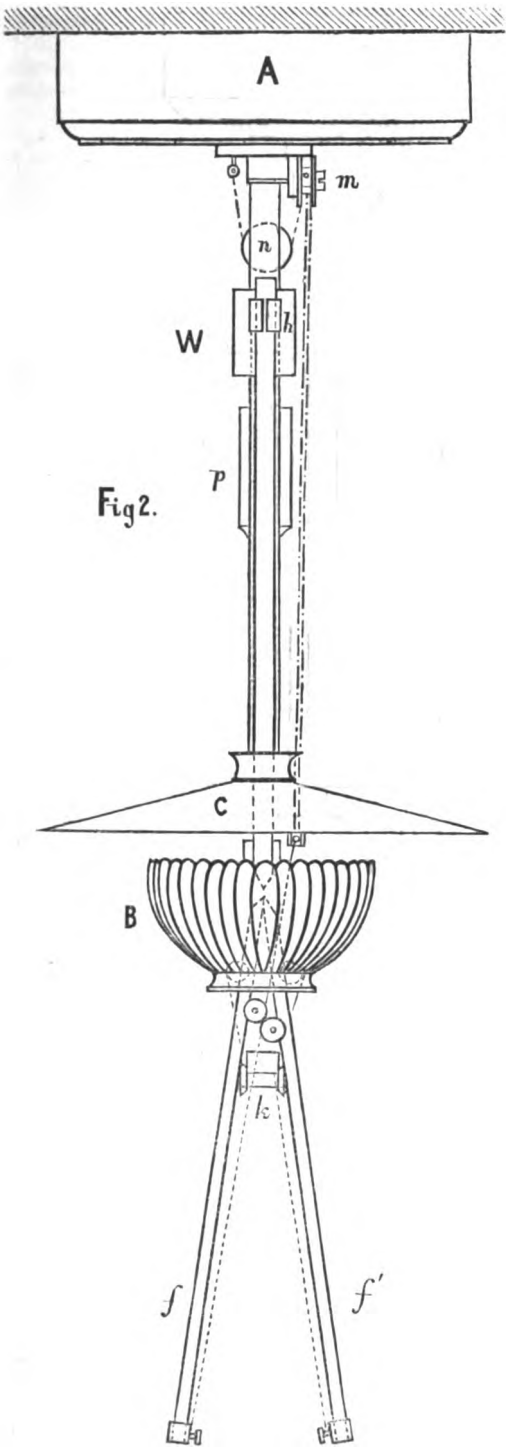

Fig 2.

much behind gas, especiallv when compared with such burners as the elegant "sun" light. And yet the electric light, from its intensity, ought to be an excellent means of illumination from ceilings.

M. Rapieff's first four-carbon regulator was not free from this objection. But the inventor has since got over the difficulty in an easy and successful manner, by simply turning his regulator upside down. In this arrangement those parts of his regulator which obstructed the light immediately below, are now placed above the reflector, and the screening effect of the under parts of the lamp is so reduced that the light of the arc is shed equably underneath.

This simple idea led the inventor to some other improvements, of which the most important is the introduction of a new arrangement which is based on the principle of subdivision of errors. It is a well-known fact that the chief and by far the most delicate requirement to be fulfilled in each regulator is the maintenance of an invariable length for the voltaic arc, and when a lamp is intended for the subdivision of the electric light, or, in other words, when a number of such lamps are to be lighted in one circuit, this point becomes still more essential to the production of a perfectly steady light.

In his new three-carbon regulator, M. Rapieff dispenses entirely with the upper pair of carbons, and substitutes a single positive carbon whose section is four times larger than that of the section of one of the pair of lower carbons for alternating currents, and eight times larger for continuous currents. The whole regulating power of the apparatus is concentrated in the lower pair of carbons, their ends being connected with the weight by two strong cords. The cord passes over two pulleys, so arranged that the descent of the weight, which likewise carries the upper carbon, is only one-half of the length of lower carbons consumed by the voltaic arc. Thus any little occasional irregularity in the upward movement of the lower carbon points becomes halved in the downward movement of the upper carbon. Suppose the irregularity in the motion of a single point to be s; then in the four-carbon regulator this irregularity may be in the most unfavourable case, say, $2s$, but in the three-carbon regulator this maximum of irregularity is only $s + 0{\cdot}5\,s$ or $1{\cdot}5\,s$. Therefore the ratio of the sensitiveness of the two regulators is respectively as 2 to 3.

The details of the three-carbon regulators are shown in the accompanying drawings. Fig. 1 is a side view, fig. 2, a front view, as seen looking upwards. The wooden hollow base A carries the two terminals for connecting the wires conveying the current, and contains the electro-magnetic arrangement for the lighting up of the apparatus which was described in the TELEGRAPHIC JOURNAL, for September 1, 1878. From this base descend two brass rods *a*, *b*, their lower ends being connected by an insulating ring *c*. On these rods there slides a cast iron weight W, of about 6 lbs., insulated from the rod *a*, by a wooden bush, and provided with a projection carrying the clips for the upper thick carbon. The mechanism of the lower pair of carbons is identical with the arrangement used in the four-carbon regulator. A brass piece *d* joins the lower carbon holder to the lever *d'*, which is actuated by the electro-magnet by means of a rod *g*. The weight is suspended on two cords,

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their ends being respectively fixed to the base *a*, and the other ends to the carbons *f* and *f'*, the cords passing over the pulleys *k*, *l*, *m* and *n*, which are so arranged, that the movement of the weight is half the speed of that of the lower two carbons. To prevent the fall of the weight by accident, a little automatic brake (not shown in the figure) is adjusted, which is always loose when the weight is suspended, but begins to press against the brass stem at the moment when by some mishap, or in recharging the carbons, the cords are relaxed, and thus stays the weight. The length of the voltaic arc may be adjusted by two screws or nuts *p* and *u*. The nut *u* simply lengthens or shortens the rod *q*, which connects the lever *d*, with the armature of the electro-magnet, and so raises or lowers the lower carbon holder. By means of the nut *p*, the upper carbon may be raised or lowered as can be seen by the figure. The pulley *n* is fixed to a cross-bar provided with a rod sliding in the weight W. The end of the rod is threaded and fitted with a cylindrical nut *p*, which thus actually supports the whole weight. By screwing the nut up or down, the weight respectively rises or descends, and with it the upper carbon *g*.

The whole apparatus is more compact than the four-carbon regulator, and no part of it is subjected to the injurious influence of the heat generated. A large reflector C is added to project the whole light below, and a saucer-shaped opal shade B softens the dazzling brilliancy of the voltaic arc to an agreeable, yet bright light. A large portion of the light is unshaded, and, reaching the walls is reflected back into the room, thus adding to the general illumination and preventing the great loss of light occasioned by the use of opal globes. Lastly the new regulator is much better adapted for being fitted up as an ornamental lamp.

THEILER'S NEW SOUNDER.

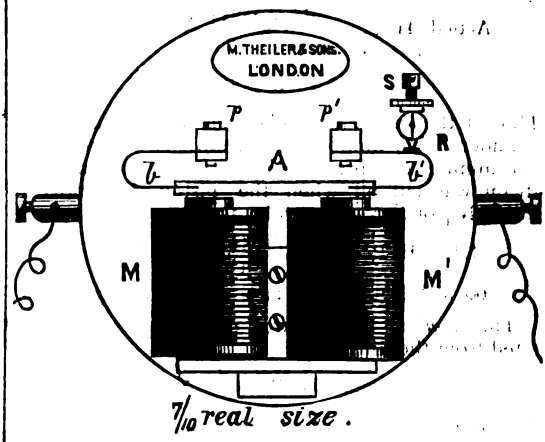
MESSRS. THEILER & SONS have lately designed and are now making a very simple, but highly efficient, form of sounder which is free from the objections which have been raised against the ordinary form of instrument. In the new pattern the dash is readily distinguished from the dot by the longer *duration* of the sound, the latter resembling a bugle note which can be made loud or soft at will.

The fig. shows a plan of this extremely simple instrument.

The vibrating reed A consists of an iron armature attached to two flat springs *b b'*, which are bent into U shape (to save space), and which are firmly fixed to the pillars *p p'*. The electro-magnet M M' is planted as close as possible to the armature A without actually touching it. The adjustable contact S impinges on the spring *b* at R, but breaks connection as soon as A is attracted by M M'. In order to secure the parts firmly in their place the whole is mounted on a hollow metal base, to which a bottom of thin Swiss pine is screwed, thereby increasing the sound very considerably.

A single Fuller's cell is sufficient to work this sounder satisfactorily, and Messrs. Theiler have no doubt of being able to make a sounder on the same principle which will work with the direct line current.

Theiler's sounder differs from similar acoustic apparatus in having no *free* end to the vibrating



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reed; the sound, therefore, starts and ceases the *very instant* the key makes and breaks contact.

We have had an opportunity of examining one of these instruments and can testify to their efficiency.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

I.

Messrs. Robey and Co.'s Patent Fixed Engine.

THE question of the engine power required for driving dynamo-machines employed in producing the electric light has received considerable attention lately, and many engineering firms have manufactured engines which are remarkably well adapted for the purpose.

Before proceeding to describe any of these engines, we would draw attention to the cause of the large discrepancies which exist when comparisons are made from the popular accounts of electric light trials, the discrepancies we mean as regards the horse-power required to produce the light. This almost entirely arises from *nominal* horse-power being confounded with *actual* or *indicated* horse-power. Now there is, almost always, a very wide difference between these quantities. The *actual* horse-power is often 4 or 5 times the *nominal* horse-power. As the former quantity is the only true index of the work done in producing the light, it should always be the one employed in making calculations for comparisons. The *actual* horse-

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power is calculated with great facility. Thus, if we have given

Length of stroke in feet $= l$;
Diameter of cylinder in inches $= d$;
Pressure of steam in lbs. per square inch $= p$;
Number of revolutions of fly-wheel per minute $= n$;
Point of stroke at which steam is cut off $= x$;
then

$$\text{Actual H. P.} = \frac{d^2 \times \cdot7854 \times l \times 2n}{33000} \times \text{P}x\,(2\cdot3 \log \tfrac{1}{x} + 1)$$

Thus if the length of stroke were 1 ft., diameter of cylinder 6 in., number of revolutions of fly-wheel per minute 100, pressure of steam 60 lbs., and the steam was cut off when the piston had moved through $\frac{3}{4}$ of its entire stroke, that is $x = \frac{3}{4}$, then

$$\textit{Actual}\ \text{H. P.} = \frac{36 \times \cdot7854 \times 1 \times 200}{33000} \times 60 \times \tfrac{3}{4}\,(2\cdot3 \log \tfrac{4}{3} + 1) = 10, \text{ very nearly.}$$

The *nominal* horse-power of an engine is calculated from the formula

$$\text{Nominal H. P.} = \frac{d^2 \sqrt[3]{l}}{15\cdot6}$$

Taking the values we have given to d and l, we get

$$\textit{Nominal}\ \text{H. P.} = \frac{36 \times 1}{15\cdot6} = 2\cdot3,$$ which is very considerably less than the *actual* horse-power.

We cannot too strongly insist upon the necessity n all trials of the electric light of the *actual* or *indicated* horse-power of the engines being given and not the *nominal* horse-power; and we are inclined to think that if this was done, the results of some of the trials would be by no means so favourable to the light as one is led to suppose, although as regards the engines the results would prove highly creditable to the engine makers.

The engine of which we give an illustration, is manufactured and designed by Messrs. Robey & Co., of Lincoln. It is admirably adapted for driving the dynamo-machines, and is especially remarkable for the small space it occupies, its regularity of speed, large margin of power, and regularity in running; this latter point is especially valuable, as upon it depends very much the steadiness of the light.

The locomotive type of boiler employed enables about 20 per cent. more water per lb. of coal to be evaporated than would be the case in one of the Cornish or egg-ended form. There is no loss due to the leakage or radiation from steam pipe and other large surfaces. The boiler working with an artificially strong draught, an inferior, and therefore cheaper class of fuel can be used.

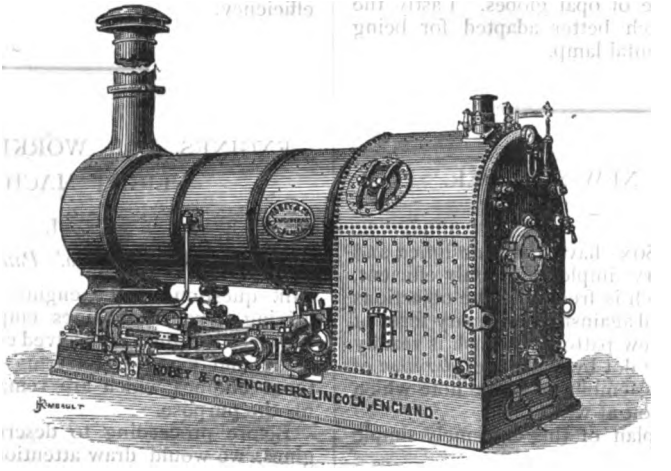
The engine parts are fitted up with all modern improvements, the cylinders are steam-jacketed, and the valve gear is arranged to work with variable degrees of expansion.

The result of the whole being an economy of fuel, as proved by actual comparison with the old type of engine doing the same work, of from 20 per cent. to 50 per cent.

As will be seen, the entire engine is erected on a massive cast-iron bed-plate, so that the boiler is relieved of all strain due to the engine, and is confined to its legitimate purpose—that of raising steam.

The base-plate is formed at one end into an ash-pit, with damper doors, and is made suitable for receiving the fire-box end of the boiler—the other end of which is carried by a crutched-shaped casting fixed over the cylinders.

The end of the base-plate under the cylinder is formed into a feed water tank, into which the cylinder cocks discharge all condensed water, and into which a portion of the exhaust is so directed as to heat the feed water to nearly boiling point before going into the boiler.



The whole of the parts of both engine and boiler being included on one foundation or base-plate, heavy and expensive foundations are dispensed with—the weight of the boiler and its contained water acting as an extra weight to assist in keeping the whole machinery in rigid position.

The 16 "Jablochkoff" lights recently employed for lighting the Billingsgate Market were produced by a dynamo-machine, driven by one of Messrs.

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Robey's 20 *nominal* horse-power engines; the boiler pressure being 60 to 80 lbs., the point of cut-off one-half, and the *indicated* horse-power 23.

It will be noticed that in this case, the indicated horse-power was but very little in excess of the nominal horse-power. The form of engine is capable, if necessary, of working up to 60 indicated horse-power.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

CLERAC'S TUBE.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—Enclosed I send you official communications just received from the French Government relative to Clerac's Tube.

Sincerely yours,
3rd Feb., 1879. D. E. HUGHES.

"Paris, le 1er Février, 1879.

"MONSIEUR LE PROFESSEUR,—Conformément au désir que vous m'avez exprimé, je vous adresse ci-joint une série de documents établissant que les tubes de resistance ou rhéostats à charbon imaginés par Monsieur Clérac, remontent certainment à une date anterieure au 4 Mars, 1866.

"Recevez, Monsieur le Professeur, l'assurance de ma consideration tres distinguée,

"COCHERY,
"Le sous Secrétaire d'Eat des Finances.

"Monsieur le Professor Hughes,
"94, Great Portland Street, London, W."

The following is a translation of the above letter:—

"Paris, Feb. 1, 1879.

"MONSIEUR LE PROFESSOR,—Conformably to the desire that you have expressed to me, I send you herewith a series of documents establishing that the resistance tubes or carbon rheostats, invented by M. Clerac, go back certainly to a date anterior to the 4th March, 1866.

"Receive, M. le Professor, the assurance of my very distinguished consideration,

"COCHERY,
"The Under-Secretary of State for Finance.
"(Now Minister of Posts and Telegraphs.)

"Professor Hughes,
"94, Great Portland Street, London, W."

[Here follows the original letter from Professor Hughes to M. Clerac respecting his tubes, which we published in the Correspondence of our last number. It bears the Paris postmark for March 10, 1866, on its back.—Ed. T. J.]

The other documents are:—

"Paris, January 27, 1879.

"My dear M. Clerac,—It was in 1866 that I delivered to the Administration des Telegraphes the first Hughes' apparatus that I constructed. It was equally in the same year that I was nominated a member of the Comité de Perfectionnement de Lignes Télégraphiques, of which Professor Hughes was also a member. These dates make me absolutely certain that Prof. Hughes spoke about and described to me, either at the end of 1865 or in the beginning of 1866, your rheostat formed of powdered carbon or pulverised plumbago, which you mixed more or less with other substances, and which you compressed more or less I recollect perfectly this little tube which I held in my hands, and in answer to my question, 'Can this serve as a standard of resistance?' Professor Hughes replied that you had found that the conductivity was variable with the pressure. (M. Hughes m' a repondu que vous aviez reconnu que la conductibilite etait variable avec la pression.)

"All this, my dear M. Clerac, I recollect perfectly, and I attest it willingly to you by this letter, begging you to believe me,

"Votre plus devoué,
"E. HARDY,
"Ingenieur-Electrician.
"5, Avenue de la Motte Piquet, Paris."

"Paris, January 27, 1879.

"I, the undersigned, declare that I constructed in the course of the year 1873, with carbon, metallic, and other powders, agglomerated by means of fatty bodies, sundry resistance apparatus, which had for their starting point (qui avaient pour point de départ) the economical rheostats, formed of powdered carbon compressed in insulating tubes by regulating screws, invented anteriorily by M. Clerac.

"(Signed) BEAUFILS,
"Chemist, Chargé du Laboratoire à la Reception du Material."

"Paris, January 27th, 1879.

"L'Inspecteur-ingenieur, Chargé du Service de la Reception du Materiel des Telegraphes, certifies to having made use in 1873 for to establish leakages (etablir des derivation) on lines from Paris to Marseilles, some of the resistance apparatus which form the subject of M. Beaufils' certificate.

"(Signed) LAGARD."

"Paris, January 28th, 1879.

"The undersigned certify to having executed towards the end of the year 1865, and during the year 1866, according to the instructions of M. Clerac, and under his direction, certain rheostats of powdered charcoal and graphite, dried, and compressed in glass and wooden tubes by aid of a regulating screw, whose degree of pressure permitted the resistance to be varied.

"This work was done in the premises set apart for the course of instruction on the Hughes' apparatus at the seat of the Administration des Télégraphes, Paris. "(Signed)

"L. MANDROUX, L. RAULT, L. BARDEZ."
Agents speciaux des Telegraphes a l'Administration Telegraphique.

The following letters on the above subject have also been addressed to the TELEGRAPHIC JOURNAL.

SIR,—Prof. Barrett's arguments would be more readily understood as coming from a lawyer rather than from a man of science. He pretends that since I did not speak of the variation of resistance with difference of pressure, in my note of 1874, to the *Journal Telegraphique* of Berne, it was because I was ignorant of the phenomenon. To that the reply is easy: I had no call in a note of several lines to give the theory of my apparatus, but only to set right an allegation of M. Zetzsche who attributed that invention to a German. It will suffice to re-read my note and the article to which it replied for to convince any one that there was no need then either to describe the article or to give the theory of it.

If now any one examines my tubes, he will be led to ask himself why I employed pressure screws, if it was

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not for the purpose of varying the compression of the powder until the resistance sought is obtained.

Further—and this is a criticism that I have myself addressed to my inventions since the beginning—as Prof. Hughes will be able to recall—the variations of temperature in dilating or in contracting the glass or wood, produced variations of the resistance of the powder; but it is not necessary to be *un grand savant* for to render an account of that phenomenon. These changes of resistance proceeded from a variable state of compression of the powder which was of necessity subjected to the mechanical action exerted by temperature on the tube which contained it. I have truly no merit in explaining this simple cause which has struck all those who have handled my tubes. I will add besides, that if it had been able to escape my own notice it would certainly not have escaped that of everybody else at that time.

I believe that it would not have said much for Prof. Barrett, supposing he had been in my place, if he had hesitated a single instant to recognise the cause whose effect he had thus ascertained. This being so, is it possible for any unbiassed mind to suppose that I could not then explain the action of pressure?

To sum up, in whatever manner I reason, I cannot find the least appearance of solidity in the arguments of Prof. Barrett, and it seems to me that it is only necessary to ask my tube itself in order that it should respond for me.

HIPPOLYTE CLERAC,
Inspecteur Ingenieur des Telegraphes.

Paris, Feb. 3, 1879.

Allow me, sir, some new reflections on the subject of the pretensions of Mr. Edison mentioned in the last letter of Professor Barrett.

Even admitting that the tubes of Clerac were not furnished with resistances variable with pressure, which is contrary to the opinion of all those who have had acquaintance with these tubes, it does not therefore follow that Mr. Edison made that discovery, even for carbonaceous powders. For here is what I have myself published on this subject in the *Comptes Rendus* of the Academy of Sciences for Dec. 2, 1872, in regard to the electric resistance of carbon powders and metallic filings:—

"The resistance of the middle medium with dry powder of wood charcoal was from 1,200 to 2,000 kilometres of telegraph line, and with metallic powders or retort carbon, from 1,200 to 2,000 metres, according to the more or less brilliant state of the surface of the metal grains and their degree of closeness (tassement) round the electrodes, &c."

For the rest I have been occupied with this question at four different times since 1856.

1. In 1856 I studied it from the point of view of the imperfect contact of the metallic studs of current interrupters (see my *Exposé des Applications de l'Electricité*, 2nd Edition, Vol. I., p. 246).

2. In 1864 I studied it from the point of view of the relative insulation of the spires of an electro-magnetic helix with bare wires (see my Memoirs on this subject in the *Annales Telegraphique*, Vol. VIII., p. 211, the numbers for March-April, 1865).

3. In 1872 I studied it from the point of view of the conductivity of semi-conductors (see the *Comptes Rendus*, Dec. 2, 1872).

4. In 1874 I studied it from the point of view of the application of electrodes on ligneous bodies (see my Memoirs in the *Comptes Rendus* for July 6, 1874, Aug. 10, 1874, Sept., 1874, and May 2, 1875).

Like Professor Barrett, I concluded that the effects determined by the pressure proceeded from a more intimate contact of the molecules of the bodies at the point of contact. The following is what I said, in fact in my note of July 6, 1874:—

"It is always the case that the conductivity is in ratio to the degree of pressure of the plates of communication. This last action evidently depends on the *greater or less intimacy of contact which is produced at the time between the two superposed surfaces.* For in substituting a drop of distilled water instead of the pressure, we immediately get, with the plate simply placed upon the table, the maximum of deviation, just as if these plates had been pressed by presses."

This question of indifferent contacts has engaged my attention during twenty years. I have even devoted a chapter to it in my *brochure* on the conductivity of semi-conductors, and Mr. Edison cannot honestly call himself the author of a discovery made when he was hardly six years of age. It is, therefore, not without a certain sentiment of regret that I see Mr. Edison, whom I was the first to herald into France, continue to sustain pretensions which cannot be sustained, and to put forward as his own an apparatus under the name of *Pressure Rheostat*, and which is only the Clerac Tube with a micrometer added. Such a course of action is unworthy of him.

Accept the expression of my best sentiments,

DU MONCEL.

MR. HERRING AND THE POST OFFICE.

SIR,—You are quite right in maintaining the necessity for a "third party to mediate between inventors and telegraph officials." The letter of your correspondent "M" simply furnishes additional reasons for such necessity. He ignores my complaint altogether, and because I have resolved not to submit any further invention to the telegraph department until the authorities have dealt with such complaint, he "deplores my apparent lack of practical familiarity with current telegraphic requirements," and asks me to "betake myself heart and soul to the improvement of sounders" in order to "win *his* admiration."

Pray allow me to inform your correspondent that an agreement exists between the Post Office and myself to refer the value of my invention to Sir William Thomson, Professor Fleeming Jenkin, Mr. Latimer Clark, and Mr. Forde, and that until those eminent gentlemen have been called together and all the facts necessary for a full and fair trial of my system have been submitted to them as the official referees, it is not my intention to hold any altercation with anonymous correspondents. At present the Post Office has broken faith with me upon all points. It promised that there should be a full and fair trial of my system. It invited me to make costly preparation for such trial. It induced me to engage and to pay two eminent scientific gentlemen to represent me at the trial. It arranged and signed terms of reference. It promised to adopt my system if the trial proved satisfactory. It obtained possession of my instruments under a written promise to proceed with the trial. It broke all those promises. It has given no reason for doing so. It has never appointed a meeting of the referees. It has not replied to my application to be reimbursed for the consequent loss of my time and my money. It has neglected to deal with my petition for redress although such petition has been referred to by the Crown. When your correspondent "M" can point with pride to an administration of the Government Telegraph Department of England in which such proceedings are impossible, he may then rely upon my hearty co-operation in every endeavour to improve telegraphy. As a matter of fact, however, I do not like the Morse system at all, and Sir William Thomson and Professor Jenkin in a recent report state:

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"We are far from believing that the present Morse system can be regarded as final." This opinion is also shared by the highest authority on the working of land lines, Mr. Latimer Clark. Your correspondent "M," therefore, must be prepared for any difference of opinion which I may hereafter express as to the policy of extending the use of his favourite Morse sounder. Many telegrams contain the pith of private matters which the sounder discloses to waiting ears. Even the Morse transmitting key, in a quiet suburban office, gives no uncertain sound to a practised listener. I know several offices to which my remarks apply, where either under the pretence of waiting for an omnibus or preparing a telegram, secret information might readily be acquired either from a Morse key in sending or a Morse sounder in receiving.

RICHARD HERRING.

27, St. Mary's Road,
January 24, 1879.

[W. L., F. D. and F. J. S.—Your letters will appear in our next.—Ed. T. J.]

Notes.

SIEMENS' ELECTRIC LIGHT was tried at an oratorio in the Albert Hall on February 13th, with great success.

THE WALLACE-FARMER LAMP (supplied by the Anglo-American Light Company of Hatton Garden) has been tried with success at the P. and O. sheds of the Southampton Docks.

THE electric light has been discontinued at Billingsgate and at Westgate-on-Sea on the score of cost.

FOGS AND THE ELECTRIC LIGHT.—During a recent snowstorm in Paris the Jablochkoff candles in the Avenue de l'Opera were lit and the darkness dispelled by the reflection of the electric beams from the snowflakes. The occasion of a fog is also awaited to try their illuminating effect. If it is successful, that is if the light will penetrate the fog for 20 metres, Jablochkoff lamps will be established at the busiest points of the city. Fogs are a somewhat rarer and less violent phenomena in Paris than in London, yet we have had no attempt made to lighten their darkness here, notwithstanding the fact that the mere starting of the machine gives the light.

AT the Physical Society on Feb. 8, Mr. Shoolbred gave an account of all the machines and lamps used in electric lighting. With regard to the De Mersaune regulator, which works mechanically by bevelled gearing, he said that it had been highly spoken of at the Paris Exhibition. The Wallace-Farmer light, though lasting was unsteady, perhaps because only natural gas carbon had as yet been used. With regard to the cost of Jablochkoff's system, experiments in Paris had shown that whereas the other lamps cost only 5d. per light per hour, Jablochkoff's cost 10d. per light per hour. The De Méritens candle was also shown. It consists of three upright parallel sticks of carbon, the outer two being the electrodes, while the middle one forms a stepping stone to the arc between them. After alluding to the fact that the positive upper carbon assumes a crater form which reflects the light down in such a way that the line of maximum intensity of light slopes downwards at an angle of 60° from the vertical axis of the carbons, Mr. Shoolbred pointed out that by placing the upper carbon a little behind the lower, Mr. Douglas had raised the line in question to horizontality. He also stated that in Paris the Jablochkoff light waned longer than it waxed, whereas in London it waxed longer than it waned, and suggested that the cause might reside in the fact that the London engines work more nearly at the speed of the machines, and the machines themselves are founded on stone and not wood as in Paris. Mr. Werdermann said that all carbon lights were partly due to the arc and partly to incandescence; his own lamp giving an arc as well as the others. The size of this arc could be regulated by pressure between the electrodes. He also stated that he hoped to show ere long that it was as easy to produce 500 currents as 10 from a single current, and observed that the size of the carbons greatly altered the intensity of the light. Professor Ayrton said that the difficulty of subdividing the light was not an electrical one, but lay in the fact that the amount of light produced is not in proportion to the amount of heat produced. In contradiction to Professor Ayrton, Mr. Werdermann maintained that the opposing electromotive force in the voltaic arc was directly proportional to the original electro-motive force. Professor S. P. Thomson pointed out that residual magnetism in the cores of the electro-magnets of machines lowered their efficiency, and hence short cores as in the Wallace-Farmer machine were advantageous.

DURING the four months from the beginning of October to the end of January last some eighty British patents have been taken out for electric lighting. It is a remarkable fact that the rush for patents which languished about Christmas time has begun again with renewed vigour; the obvious deduction being that plum-pudding is inimical to invention.

EDISON'S FOREIGN SPECIFICATION was published in extenso in the *Standard* for February 10th, but without diagrams. It describes a means of generating vibratory currents for the electric light by the vibration of magnetic rods in front of bobbins, a commutator being used to make the alternating current continuous if necessary. The mutual reaction principle may be applied herein if the rods are electro-magnets. The electro-pyres or metal burners are strips, rods, and beads of platinum, iridium, ruthinum, rhodium, ozmium, titanium, &c., oxide of titanium and other conducting oxides, silicon, boron, &c. The intensity of the light is regulated by the expansion of the electro-pyre from heating. This expansion operates a spring lever which throws in a shunt of wire, or one of carbon whose resistance varies with the degree of expansion of the electro-pyre. The expansion of gas heated by the electro-pyre is also used as a regulator. Secondary batteries giving a continuous current from a discontinuous one are also employed. The patent, whether practicable or not, displays Mr. Edison's accustomed ingenuity.

THE TELEPHONE.—We have received the first number of Vol. II. of the *Telephone Journal*, published in Chicago. It is the organ of the Bell telephone in Illinois, being devoted to the propagation of the Bell telephone, and is, in short, a trade circular in the guise of a paper. The striking feature in it is the list of subscribers to the "Telephone Exchanges" of Chicago and Louisville, who are connected by telephone through a central office. The list for Chicago actually forms a business directory, numbering over 600 names of the principal firms, offices, hotels, clubs, and shops in the city, giving over 5,000 calls daily; yet it is only six months since the Exchange was started. This truly

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American go-aheadness is astounding compared to the slow progress of the telephone in England; but let us hope it will be stimulating. These Telephonic Exchanges are being rapidly introduced into all the large American cities from New York, which has already 750 subscribers, down to Detroit, which has only 150. There are actually 17,500 instruments in use, and of these some 15,000 are rented. The suit brought by the Bell Company against the Gold and Stock will probably come on for trial in April or May. The plea of the latter is that Gray invented the telephone prior to Bell.

THE MICROPHONE, as we have before stated, has been successfully applied by Professor Rosetti to the detection of minute seismic vibrations at Vesuvius and on the Solfatara of Possuoli. The subterranean noises heard by means of the microphone are classed by Professor Rosetti as rumblings, musketry reports, and metallic or bell-like sounds. A comparison of these microphonic sounds with the motions of the seismograph in Professor Palmieri's observatory at Vesuvius shows that the rumbling sounds correspond to undulatory motions, and the cracks to perpendicular motions. Being far more sensitive than the seismograph, the microphone reveals earth tremblings which otherwise cannot be noted. At Rocca di Papa on the Alban Hills Professor Rosetti could hear the characteristic seismic noises in the crater of an extinct volcano.

DR. BLECKRODE has observed that a microphone through which a strong current is passed emits a sound. He attributes the latter to the electro-dynamical action of the current on its movable part. M. Julius, of Breda, Holland, as it will be remembered, referred the microphonic action to dilatation of the carbon points through increase of temperature, while Mr. Varley has attributed it to a small cloud of carbon dust, or voltaic arc between the points.

COWPER'S TELEGRAPHIC PEN will be described to the Society of Telegraph Engineers at the next meeting on February 26th.

THE TELECTROSCOPE is the name given to a plan of M. Senlecq, of Ardres, France, for telegraphing the images produced in a camera. The device consists in an autographic telegraph similar to D'Arlincourt's, but the sending pencil is of selenium, which, as is well known, varies in electric resistance with the degree of intensity of the light falling onit. This pencil is connected up to the battery and line in such a way that as it crosses the surface of the glass plate on which the image is focussed in the camera it receives more or less light according to the shading of the image. These gradations of light are attended by corresponding gradations in the line current, and by means of an electro-magnet at the receiving end these variations of current are caused to produce a greater or less pressure of the marking crayon on the paper there. The plan exists as yet in idea; but like M. C. Borseuil's imaginary telephone, it is worthy of record as the first attempt to transmit photographic images by electricity.

WE are informed that Major Webber, R.E., and Mr. C. E. Spagnoletti, C.E., the former being vice-president of class 65, and the latter supplementary juror of group 6 (Electrical section) at the Universal Exhibition, Paris, last year, have had the honour of being presented with a proof portrait of H.R.H. the Prince of Wales, accompanied by a gracious letter of thanks for their services from His Royal Highness as a personal mark of their connection in the work of the Paris Exhibition.

A DUPLICATE TRANS-AUSTRALIA LINE is proposed.

WE have received the report of the American Telegraphers' Mutual Benefit Association, New York, President, J. D. Reid, from which it appears that notwithstanding the severe drain on the society, caused by the yellow fever epidemic, there is a handsome balance for the year.

THE Direct United States Cable broke down on Jan. 4. The *Minia* is out on the repairs near Torbay.

IN the new French governmental arrangements M. Cochery has been appointed minister of Posts and Telegraphs.

SIR CHARLES WHEATSTONE'S PAPERS.—The Physical Society's reprint of Sir Charles Wheatstone's papers will be ready in a few days.

WE have received the Journal of the Melbourne Electrical Society for May-October, 1878. The society, which has been in existence four years, now numbers over 100 members, including ladies.

UNDERGROUND LINES IN PHILADELPHIA.—In 1877 several underground lines were laid in Philadelphia after a plan of Mr. David Brooks, and in connection with the working of the city railways. One of these lines crossed the Schuykill river. The line consists in cotton-covered copper wires laid together into cables and pulled through iron pipes, which are then filled with paraffin oil. In this way fifty No. 18 copper wires are easily drawn into a pipe 1 inch in diameter. The most convenient length for drawing in and splicing is 1,000 feet. The oil solidifies at 20° below zero F. The insulation is 2,500 megohms per mile at 40° F. The system, which is specially useful for telephone circuits, has been patented in all foreign countries, and a company has been formed to work it under the title of the "Brooks Underground Telegraph Construction Company, Limited," Philadelphia.

WE have received the following small drama from our facetious correspondent *Will-o'-the-Wisp*.

THE INVENTOR AND THE OFFICIAL.

SCENE.—The general Post Office, St. Martins-le-Grand.

BRITISH TELEGRAPH OFFICIAL discovered at his desk.

Enter an OLD INVENTOR.

B. T. O. *(Warmly.)* "How do you do, Mr. Crazytop? Delighted to see you. I haven't seen you for an age."

O. I. *(Humbly.)* "Pretty well, thank you. I've been very busy lately. I've got something good here to show you; a fine idea; save no end of money. I patented it a year ago, and I've been at work on it ever since."

B. T. O. *(Warmly.)* "Oh, indeed; I'm very glad to hear it. You know we are always ready to welcome any new thing."

O. I. "Especially if it's American."

B. T. O. "Hum. Let us see this instrument."

O. I. "There she is." [*Explains its merits.*] "You see that it will be a great saving to the service."

B. T. O. *(Warmly.)* "Well, we'll have it tried, Mr. Crazytop."

O. I. *(Humbly.)* "If you please, I should like to experiment with it a little while myself on a real line, so as to improve and perfect it. Of course I have no telegraph line in my house, and I must come to you for one."

B. T. O. *(Warmly.)* "By all means, Mr. Crazytop, if you pay for it."

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O. I. *(Gloomily.)* "I can't pay for it."

B. T. O. *(Warmly.)* "Well, good-bye, Mr. Crazytop, I shan't see you for some time; I'm going to have a trip in America on behalf of Government, to see if I can't pick up some novelties, and introduce them here."

O. I. *(Abstractedly.)* "Ah! I daresay you'll enjoy that. Good-day."

B. T. O. *(Warmly.)* "Good-bye, Mr. Crazytop, good-bye. (*Aside.*) Confound the man, he's a perfect nuisance."

DR. BURDON SANDERSON'S investigations on the exceptional property possessed by the leaves and other organs of certain plants of exhibiting definite movements in response to mechanical, chemical, and electrical stimuli, have led him to the conclusion that the exciting process in plants is similar to that which takes place in animal tissues when they are stimulated in the same way.

Proceedings of Societies.

PHYSICAL SOCIETY.

AT the meeting of this society on Jan. 25, DR. ERCK exhibited a constant bichromate of potash cell consisting of a narrow lead trough, 12 ins. long by 3 ins. wide, by 1 in. deep, lined along both sides internally with carbon plates. The zinc plate, 10 ins. long, is immersed in the solution to the depth of an inch midway between the carbons. A circulation is maintained by allowing fresh solution to drop into the cell at one end, and the old to drop away at the other. As the space between the two carbons is only half-an-inch, the internal resistance of the cell is only about ¼ ohm on short circuit. To obtain the maximum current, 8 ozs. of solution is supplied per hour. This battery is used by Dr. Erck to drive a small astronomical clock. Dr. Erck also showed a battery composed of carbon and zinc plates mounted on an axle rotated by wheel work.

Messrs. Elliott Bros., exhibited sundry novel commutators.

At the meeting on Feb. 8, DR. O. J. LODGE read a paper on the thermal conductivity of a rod, and Mr. SHOOLBRED discoursed on the Electric Light (see our Notes under this head).

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the meeting of this Society on February 12, MR. WILLOUGHBY SMITH read a paper on the "Working of Long Submarine Cables," and Mr. C. F. Varley opened the discussion.

New Patents—1879.

4. "An improved mode of and means for obtaining writings and designs for printing and other purposes by means of electricity." ALEXANDER BROWN (communicated by Gabriel Phillipe Loriss Bellet and C. H. O. Hallez d'Arros, Paris). Dated Jan. 1.

27. "Improvements in apparatus for producing electric light." B. A. RAWORTH. Dated Jan. 3.

58. "Improvement of galvanic cells and batteries." W. ERCK. Dated Jan. 6.

60. "Improvements in telephonic apparatus." JOHN IMRAY (communicated by M. Boudet, Paris). Dated Jan. 6.

65. "Improvements in electric lamps." A. M. CLARK (communicated by E. Ducretet, Paris). Dated Jan. 6.

83. "Improvements in electric lamps." W. LADD (communicated by J. Jaspar of Liege). Dated Jan. 8.

153. "Improved instrument or means to be employed in illuminating and examining internal parts or cavities of the human or animal body." (Communicated by M. C. F. Nitze, Vienna.) Dated Jan. 14.

178. "Improved means for obtaining light by electricity." A. DE MÉRITENS, Paris. Dated Jan. 15.

192. "An improved method of and apparatus for preventing rapid combustion or destruction of the electrodes used in electric lighting. G. REMINGTON. Dated Jan. 16.

229. "Improvements in telephones. W. R. LAKE (communicated by F. Blake, Jr., Weston, Mass., U.S). Dated Jan. 20.

245. "Improvements in apparatus employed in electric lighting." R. E. B. CROMPTON and P. W. WILLANS. Dated Jan. 21.

259. "An improved lamp or apparatus for shading the electric and other lights, and for producing various effects of light for scenic and other purposes." T. W. GRIEVE. Dated Jan. 22.

277. "A new or improved electrode or electric candle for the purpose of lighting by electricity, and effecting the divisibility of the electric light." SIGISMUND COHNÉ. Dated Jan. 22.

299. "Improvements in apparatus for producing light by electricity and other means." H. J. HADDAN (communicated by E. Molerd and J. Celrian, San Francisco). Dated Jan. 24.

307. "Improvements in and relating to insulated wires and cables, and in the method of insulating, fixing, and laying the same for telegraphic and other purposes." W. MOSELEY. Dated Jan. 24.

325. "Improvement in electric light apparatus." E. L. PARAIRE. Dated Jan. 27.

332. "Improved means of obtaining currents of electricity." BARON ELPHINSTONE, C. W. VINCENT. Dated Jan. 27.

338. "Improvements applicable to submarine telegraphy." A. M. CLARK (communicated by F. J. F. Ailhand, Paris). Dated Jan. 27.

359. "Improvements in electro-metallurgy and their application." H. BRITTAIN. Dated Jan. 29.

371. "Improvements in magnetic appliances and garments." L. M. BECKER. Dated Jan. 29.

389. "Improvements in and relating to reflectors for electric-lighting apparatus." W. R. LAKE (communicated by E. B. Watson, Yokohama). Dated Jan. 30.

390. "An improved protecting coating for ships, telegraph cables, and other structures or materials." G. WATSON. Dated Jan. 30.

394. "Improvements in telephones." J. H. JOHNSON (communicated by F. A. Gower and C. Roosevelt, Paris). Dated Jan. 30.

416. "Improvement in electric lamps." J. D. F. ANDREWS. Dated Feb. 1.

427. "Improvements in electric lamps." Dated Feb. 3.

454. "Improvements in means and appliances for electric lighting." R. W. H. P. HIGGS. Dated Feb. 15.

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465. "Improvements in buoys exhibiting electric light, and in batteries for generating electricity for this and other purposes." S. W. M. DE SUSSEX. Dated Feb. 5.

477. "Improvement in galvanic batteries." T. SLATER. Dated Feb. 6.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

1779. "Improvements in speaking telephones and in apparatus connected therewith." J. F. BAILEY (communicated by G. M. Phelps, New York). Dated May 2. 8d. This describes forms of Bell telephone having more than one coil and plate, dampers to the plate, plates divided into two or more vibrating areas combined with two or more coils and cores, vocalising chambers in combination with the plates, telephones with two parallel vibrating diaphragms, and an arrangement of telephone calls, &c.

1783. "Electro-pneumatic bell indicators." J. W EDMUNDSON. Dated May 3. 2d. A pendulum is set swinging either by a pneumatic or electro-magnetic signal. The swinging of the pendulum tells the attendant whence the signal came. *Not proceeded with.*

1882. "Telephones." J. F. BAILEY (communicated by G. Gray, Chicago). Dated May 10. 6d. This describes several forms of Bell telephone in which two or more simple telephones are clustered together.

1889. "Lighting gas jets by electricity." A. R. MOLISON. Dated May 10. 2d. This consists in causing a platinum wire or piece of spongy platinum to be gently heated by the current, and then allowing the gas to impinge upon it so as to intensify the heating thus begun by catalysis. *Not proceeded with.*

1917. "Transmitting and receiving electrical and telephonic excitations." A. S. HICKLEY. Dated May 13. 6d. This consists in using a diaphragm radially magnetised; or of polarised rings in sections, united by a dia-magnetic metal; and of attaching the string telephone to the diaphragms of electro-magnetic telephones in such a way that from one string mouthpiece several telephones may be operated.

1927. "Electric apparatus." P. JENSEN (communicated by A. J. B. Cance, Paris). Dated May 14. 6d. This consists in forming electro-magnets, for motors, and dynamo-machines, by building them up in concentric layers of wire and soft iron rod-cores. New forms of bent armatures and commutators are also set forth.

1937. "Coating telegraph wires." W. ABBOTT. Dated May 15. 2d. This consists in insulating wires with cotton steeped in the residuum from the manufacture of ozokerit, applied hot, and with or without any other insulating material. *Not proceeded with.*

General Science.

LIGHT AND COLOUR SENSATIONS.—M. Aug. Charpentier and Dr. Lanholt have come to the conclusion, from recent experiments communicated by them to the French Academy of Sciences, that the sensations of light and colour are the results of two distinct functions, which, although they are intimately blended in the habitual use of vision, may be clearly distinguished from each other by physiological analysis. By experiments with lenses they found that the sensibility of the eye to light was much greater when the eye is at rest in darkness than when it is in activity. There was, however, no such difference noticeable in the sensibility to colour. M. Charpentier thinks that the explanation of this fact is to be found in the discovery by Ball and Rühne of a reddish chemical substance in the retina, which is discoloured by light, and which is renewed by darkness. If we admit, as seems probable, that the optic nerve is excited not directly by light, but indirectly by the chemical modification which the light produces in the retinal red, the superior sensibility of the eye in repose may be explained by the excess of the photo-chemical substance which the eye has acquired under the influence of darkness.

AN IRON MOUNTAIN.—The Cerro de Mercado, a Mexican mountain, supposed by Humboldt to be an immense ærolite, has recently been explored by Senor Weidner, who found the hill to be deficient in the chemical constituents of meteorides—namely, iron, nickel, and cobalt, in a native or malleable state; but, on the contrary, to be largely composed of crystalline, magnetic iron, and various oxides of that metal.

FLOW OF RIVERS.—The commonly received theory of the flow of water in streams ascribes a gradually diminishing mean velocity to successive layers of water from the surface of the stream down to the bottom. Prof. James Thomson, of Glasgow, sees reason to doubt the truth of this view, and puts forward the theory that the accelerated surface water tends to sink, while the friction-retarded bottom water tends to rise and mix itself with the surface water, where it receives acceleration from gravity in running down hill.

MESQUITE.—The honey mesquite (*Algarobia glandulosa*) is one of the principal forest trees in Texas. It is a short spreading tree resembling an apple tree, and attains a trunk diameter of eighteen inches. It belongs to the leguminous family, and bears pods nine or ten inches long, containing beans enclosed in a sweet pulp like that of the honey locust. Both beans and pulp are eaten by the Indians, and sometimes by white men, though they are chiefly given as fodder to horses. It is allied to the lignum vitæ, and resembles it in hardness and durability. Fences of this timber in Southern Texas have been known to last fifty years. The poles of the military telegraph in Texas are made of it.

SEBASTINE is an explosive made in Stockholm by a company. It is a compound of nitro-glycerine, wood charcoal, and certain explosive salts. Ignited by fire sebastine burns readily, but does not explode. If confined in detonating capsules, like dynamite, it explodes with great violence. Its merit consists in its being safer than other nitro-glycerine preparations, from the fact that its mass is dryer, and the explosive oil does not escape. It is also more powerful and rapid than ordinary dynamite No. 1 (containing 75 per cent. of nitro-glycerine). Sebastine was patented in Sweden in 1872, and although the yearly output is now 60,000 kilogrammes, no accident has occurred from it during the five years it has been in use.

NOBEL'S EXPLOSIVE GUM.—Recent experiments with this new explosive at the St. Gotthard Tunnel, prove it to be of double the exploding power of dynamite. It has also the advantage over the latter of keeping for an indefinite time under water without deteriorating, an important quality in torpedo work. Camphor added fits it for gunnery.

A NEW ANÆSTHETIC.—M. P. Bert has discovered that a mixture of equal volumes of nitrous oxide and atmospheric air administered to the patient at a pressure of two atmospheres, operates as a harmless anæsthetic which produces long intervals of insensibility.

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City Notes.

Old Broad Street, Feb. 12, 1879.

THE ordinary general meeting of the proprietors of the Eastern Telegraph, Limited, was held on the 30th ult. at the City Terminus Hotel, under the presidency of Mr. J. Pender, M.P. The chairman moved the adoption of the report, an abstract of which will be found in our last issue. The Marquis of Tweeddale seconded the motion.—A Shareholder complained of the increased capital, and thought that some effort should be made to stop further increase in the future.—Mr. Barum called attention to the fact that whilst their receipts were decreasing the expenditure was increasing.—The chairman, in answer to questions, said that there could not be progress without capital, and of late years their progress had been remarkable. One of the great disadvantages under which they laboured was the codification of messages, by which two or three words were made to represent a great many. The Cyprus cable, which had cost the company £30,000, had earned at the rate of £5,000 a year.—The report was adopted with three dissentients.—Upon the re-election of the Marquis of Tweeddale being put to the meeting, the resolution was negatived by a majority, upon which a poll was demanded.—Mr. William N. Massey, M.P., having been re-elected to a seat at the board, and the retiring auditors having been also re-elected, the proceedings closed in the usual manner.—The result of the poll was in favour of the re-election of Lord Tweeddale.

The half yearly meeting of the shareholders of the Anglo-American Telegraph Company was held on the 10th inst., under the presidency of Viscount Monck. The chairman in moving the adoption of the report (of which an abstract appeared in our last issue) said, "From different causes they had been obliged from time to time to change the tariffs at which they carried messages to America, and that change rendered every comparison between any two periods useless. They had now, however, been working for nearly two years at a uniform tariff, and from the best opinions they could form in regard to the figures of the three half-years, they found that their revenue showed an increase of from 5 to 7 per cent. That was encouraging in itself, and more encouraging when they considered the depression of trade which had existed during the past two or three years, and he thought they might reckon that the 5 or 7 per cent. would be largely increased in the future, when the existing depression should have passed away. In the report the board alluded to the failure of the expedition to repair the 1866 cable; that was put into the report merely *pro formâ* because, although the fact was mentioned at the last meeting, they were unable to put it in the report. The failure was no doubt a strong warning to them in reference to laying by an adequate sum for renewal fund. The directors had laid by what they considered an adequate sum and they were glad to have been able to do so without reducing their dividend to an extent which would be excessive. He hoped that the time would come when the normal increase of traffic would enable them to pay a much larger dividend. There was one point to which he would direct attention, because it was a new source of expenditure—the superannuation fund for retiring officers. It might be well argued on general principles that it was the duty of every man to provide out of his income for his old age or a provision for his family; that, no doubt, was sound reasoning, but, unfortunately, it would be found in practice that, taking all the great employers of labour, from the State downwards, it had been deemed necessary to make some provision independently of the man's own exertions for his old age or for his forced retirement in consequence of illness or other cause. If such a provision were not made, they would have from time to time cases of absolute misery coming before the directors, which human nature would be utterly unable to resist, and provision would thus have to be made out of the funds in a fragmentary manner instead of systematically. That was the reason which induced the State to provide a superannuation for its servants, and it was found to operate exceedingly well, because it gave them a strong hold over their servants during their period of service. There was a particular reason in this company why such a fund should be established, owing to the nature of the occupation. The mirror system of telegraphy was very trying to the sight, and after some years the men who worked it frequently became altogether unable to earn their living in any other way. The board proposed that the funds of the company should be charged with only one-half of the superannuation fund, the officers themselves being called upon to provide the other half. In reference to the proposed new company, which it was said was starting in opposition to them, he said that the proprietors had no doubt seen a statement in a City article in reference to this matter; but he thought that article had been written with the view of what was called forcing the directors' hands at that meeting. The caution money of the company had not been paid as stated. The directors were fully alive to the importance of any attempt of that kind. They were taking every means in their power to protect their interests, and he trusted the shareholders would have sufficient confidence in the directors to leave the matter in their hands, and not play into the hands of the enemy by forcing them into premature disclosures. In conclusion, he congratulated the proprietors on the growing prosperity of the company. The cables were working well. The French cables had been ten years in the water, and were still working well, and he trusted that the prosperity of the company would not be interfered with. The motion having been seconded, in answer to a proprietor, the chairman stated that the board proposed to place £2,000 a year to the superannuation fund.—Mr. Jackson, whilst generally congratulating the proprietors upon the condition of the company, criticised the expenditure and advocated a reduction. He also, whilst admitting the principle of establishing a superannuation fund, expressed an opinion that they were not yet in a sufficiently prosperous condition to carry out the suggestion.—After some further discussion, the chairman, in reply, as an argument in favour of the superannuation fund, pointed to the confidential nature of the work in which they were engaged, and its deteriorating effect upon the sight. The board endeavoured, as far as possible, to curtail the expenditure, but not at the expense of efficiency. No stone would be left unturned in order to find the most durable cable for their purpose. As to the duplex cable, if they used the patent it would cost them £1,500 a year. They had been experimenting with the duplex, and had found that by it they could get 90 per cent. more work out of the cable, and if it proved a success, £1,500 a year would not be a large amount to pay. The report was adopted, and the dividends therein recommended declared. The resolution relative to the superannuation fund was met by an amendment to the effect that the matter should be postponed for six months, which, upon being put to show of hands, was carried. A poll was demanded, the chairman stating that the board held proxies to the extent of £3,000,000 in favour of the resolution. The amendment was ultimately withdrawn, upon the understanding that the matter should be again brought forward at the next meeting.

At the sixth ordinary general meeting of the

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Western Brazilian Telegraph Company (Limited) Mr. Henry Rawson presiding, the chairman, in moving the adoption of the report, of which an abstract appeared in our issue of Feb. 1st, said the directors had tried to the utmost to carry on the affairs of the Company, and if they had failed in securing a good profit last year, it was from no fault of their own, but from circumstances over which they had not, and could not possibly have, any control. He then referred to the stagnation in commercial affairs, and the difficulties against which they had had to contend through the numerous interruptions of their cables and other misfortunes. During the last twelve months they had relaid 830 miles of their cables, 730 of which were entirely new sheathed, and it had all been done with from £24,000 to £25,000 supplied by the shareholders. When he told them that 830 miles formed a third of their entire system, and that the whole of their system had cost them £1,700,000, they could not say that on this occasion they had not done the work most economically. It was very satisfactory to know that in the deep water they found that the original cable was very good. During the next year he thought they might hope to earn as good a revenue as could be earned from their lines. With respect to their capital account, they had made a debit of £70,000 for laying the cable into Maranham, according to the terms of the concession. If they had had a better revenue account he would have preferred to put the whole of this to that account, although it actually belonged to capital account. The motion having been seconded, the chairman, in reply to a question, said they had tested their cables to a very great extent, and found them better than they expected they were twelve months ago. In twelve months' time they hoped to be out of debt and difficulty. The report was then adopted.

The ordinary general meeting of the shareholders of the Submarine Telegraph Company was held on the 11th inst. at the City Terminus Hotel, Cannon Street, under the presidency of Sir James Carmichael, Bart. The report stated that the accounts for the six months ending December 31st, 1878, showed an increase over the corresponding half year in 1877, and the directors were consequently enabled, after adding the usual proportion of the receipts to the reserve fund, to recommend a dividend at the rate of 17½ per cent. per annum. The lease of the Company's offices in Threadneedle Street, which was held under Government, would expire in June, 1880, and as additional accommodation was required in the building for the exclusive use of the Post Office, her Majesty's Postmaster-General had given notice to the directors that he would be unable to extend the Company's lease beyond its present term. The board had consequently obtained an eligible site in Throgmorton Avenue, on a lease for 80 years, and had entered into a contract with Messrs. Peto Brothers for the erection of new offices for the sum of £16,229. The Chairman moved the adoption of the report. Sir Thomas Dakin seconded the motion. The report was adopted without discussion, and the dividend therein recommended declared, after which resolutions were adopted unanimously, authorising the directors to apply for a supplemental charter, giving the Company power to purchase the land and erect their offices, and also to use a portion of the reserve fund of the Company for that purpose.

The report of the India-rubber, Gutta-percha, and Telegraph Works Company (Limited) states that, after all working expenses and depreciations and providing for bad debts, the net profit for the year is £43,463. Adding £18,950 brought forward from 1877, and deducting £2,514 written off shares held by the Company, and £11,750 interim dividend paid in August, there remains a disposable balance of £48,148. Of this the directors have set aside £25,000 to the credit of a reserve fund, and they recommended the distribution of £14,100 in dividend for the last half-year, being at the rate of 10 per cent. per annum, free of income tax carrying forward £9,048 to the credit of the current year.

The report of the Cuba Submarine Telegraph Company (Limited) to be presented at the meeting on the 19th inst., has been issued. From this it appears that the gross receipts for the half year, including the balance brought from last account, amount to £16,106, and the expenses to £4,253, leaving a sum of £11,853. The balance, after providing for the preference dividend, would admit, under ordinary circumstances, of a dividend on the ordinary shares at the same rate as that declared for the corresponding period of last year. The directors regret, however, to report that the Company's original gutta-percha cable broke down in the month of September last, and that there are signs of a fault in the new india-rubber cable. Mr. Keith, the Company's manager in Cuba, is now engaged in the repair of the original cable, and when that is completed (of which intelligence may arrive at any time) he will proceed to the repair of the new cable. Under these circumstances, and having regard to the necessary outlay on these repairs, which cannot be accurately estimated at present, the directors do not think it prudent to recommend a larger dividend than 6 per cent. on the ordinary shares. After payment of the dividend of 10 per cent. on the preference and that of 6 per cent. on the ordinary shares, there will remain the sum of £4,053 to be carried forward. The directors report that in consequence of the final suppression of the rebellion in Cuba, the land lines of the Spanish Government are now competing with the company's line. A falling off in local business may therefore be looked for in future.

The Eastern Telegraph Company notifies the extension of its lines in Cyprus, from Larnaca to Nicosia and Limasol, with a uniform tariff to all places in the island.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 59½-60¼; Ditto, Preferred, 86-87; Ditto, Deferred, 34¼-34¾; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅜-6⅞; Cuba, Limited, 8½-9; Cuba, Limited, 10 per cent. Preference, 15½-16; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10-10½; Direct United States Cable, Limited, 1877, 11⅜-11⅞; Eastern, Limited, 7¼-7½; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1887, 100-103; Eastern, 6 per cent. Preference, 11¼-11½; Eastern Extension, Australasian and China Limited, 7⅜-7⅝; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; German Union Telegraph and Trust, 7½-8; Globe Telegraph and Trust, Limited, 5-5½; Globe, 6 per cent. Preference, 10½-10⅝; Great Northern, 7½-8; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 10-11; Submarine, 220-230; Submarine Scrip, 1⅞-2⅛; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 8¼-8⅝; Ditto, ditto, Second Preference, 7⅞-8¼; Western and Brazilian, Limited, 2⅝-3⅛; Ditto, 6 per cent. Debentures "A," 85-90, Ditto, ditto, ditto, "B," 80-85; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 31-32; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2⅛-2¼; India Rubber Co., 10¾-11¼.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.
VOL. VII.—No. 146.

THE CAPE CABLE.

IT has been a satisfaction to the general public, as well as to electricians, to learn that the Government have resolved to lose no time in connecting the South African Colonies by cable to the mother country. On February 21 an influential deputation, including Col. Mure, Sir J. Hay, M.P., Mr. Donald Currie, and a number of influential members of Parliament, waited upon Sir Michael Hicks-Beach, who stated that several definite proposals for a cable were now under consideration of the Treasury and Post Office authorities. The recent disaster in Zululand has rendered it incumbent on the Government to possess cable communication with Natal as soon as possible, and forced on the long-deferred realisation of a cable to the Cape. The route chosen will almost certainly be the east coast route, from Aden to Natal. The reasons in favour of this route at such a time are obvious. It is shorter and better known than the west coast route, and the duplicate Mediterranean and Red Sea cables of the Eastern Telegraph Company connect it more securely to England than could the Brazilian Submarine Company's line from St. Vincent to Lisbon. Sir James Anderson has somewhere stated that this cable might be made and laid by next October; but, as was pointed out by Col. Mure to Sir Michael Hicks-Beach, there were 1400 miles of the Australian duplicate cable already made which could be purchased, so that the time of completion of the line might be shortened.

It must not be forgotten, however, that although the east coast route is undoubtedly the safest and best in an emergency like the present, it cannot be considered an "alternative route," for to lay intercolonial lines of communication in the Mediterranean is trusting all the eggs to one basket. When the advantages of the new cable have been felt, however, we may expect that a west coast cable will soon be achieved, not only as an alternative line but in order to link our west coast possessions with England.

ON ELECTRICAL INSULATION IN HIGH VACUA.

By WILLIAM CROOKES, F.R.S.

THE experiments here described were tried nearly two years ago. They were suggested by some observations I was then making on the passage of an induction current through highly exhausted tubes. The main branch of the research being likely to occupy my attention for some time, I may be unable to return to these less important offshoots. I have ventured, therefore, to embody them in a short note for the "Proceedings of the Royal Society."

A pair of gold leaves were mounted, as for an electroscope, in a bulb blown from English lead glass

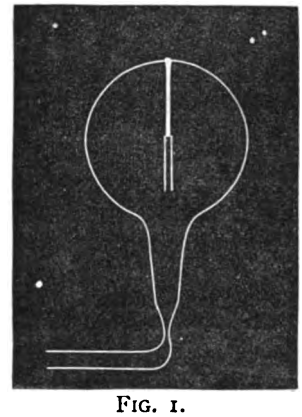

FIG. 1.

tubing. The leaves were attached to a glass stem, and the lower part of the bulb was drawn out for sealing to a Sprengel pump, as shown at fig. 1. A stick of ebonite, excited by friction, was generally used as the source of electricity, but any other source will do as well, if not too powerful.

No special attention was paid to the action of electricity on the leaves in air or in moderate vacua, as it agreed with what is well known. The exhaustion was pushed to a very high degree (about the millionth of an atmosphere); it was now found that the excited ebonite had a much greater effect on the gold leaves than it had at a lower exhaustion; but for a long time I was not able to charge the leaves permanently, as they fell together as soon as the source of electricity was removed.

When a hot substance was brought near the bulb facing a gold leaf, so as to warm the glass, molecular repulsion took place, and the leaves retreated from the warm spot, standing out at an angle of about 45°. As the glass cooled, the leaves resumed their former vertical position.

While the leaves were repelled from the hot glass, it was found that the excited ebonite had a very powerful action on them, and if it were brought near hastily, the leaves flew off to the side of the glass, destroying the apparatus. By careful management, however, the source of electricity could be brought near the warm spot of glass, when, after one or two trials, the leaves suddenly extended at an angle to each other. The appearance was as if a spark had been able to pass across the bridge formed by the line of advancing and retreating molecules connecting the hot glass with the gold leaves. The ebonite was now removed and the glass allowed to cool, when it was found that the repulsion of the leaves was permanent. The rubbed ebonite would attract and repel them as it was moved to and fro, but the angle, formed by the leaves with one another, remained unchanged. A warm body brought near the glass opposite one leaf would repel the pair as a whole; on then warming the opposite side of the glass, repulsion on that side took place, the angle of the leaves being somewhat diminished, but, on cooling, the leaves opened again to their former extent.

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When the glass bulb was strongly heated by a spirit flame the leaves suddenly discharged and fell together.

Another bulb (fig. 2) was prepared, containing a plate of mica *a*, which could be suddenly placed between the gold leaves *b b*. The plate of mica was longer and wider than the gold leaves, and was connected with a small piece of iron wire, capable of moving up and

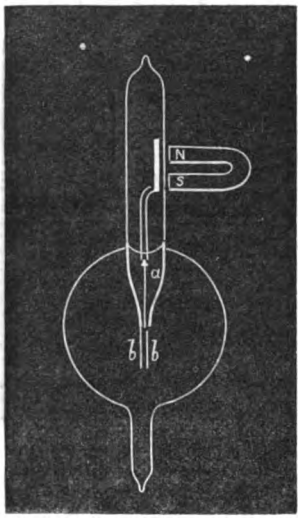

FIG. 2.

down a tube sealed into the top of the bulb. By means of an outside magnet the mica plate could thus be lowered between the gold leaves or raised out of their way, as desired. The tube was exhausted in about the millionth of an atmosphere, the mica plate being held quite above the leaves. One side of the bulb was then heated, and the leaves permanently charged by means

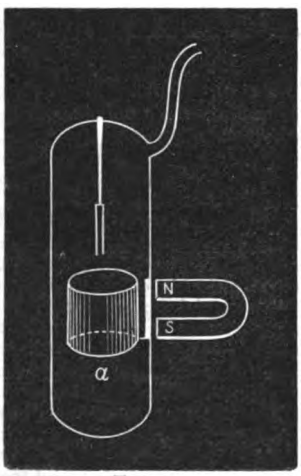

FIG. 3.

of the excited ebonite. The mica plate was now carefully lowered. As it came between the gold leaves they diverged further apart, and kept so as long as the mica plate was between them. On removing the plate the leaves reassumed their former divergence. This could be repeated any number of times.

A similar piece of apparatus (fig. 3) was made, only instead of a mica plate coming between the leaves, a mica cylinder *a*, was made capable of being raised and lowered outside the divergent leaves. I was not able to get entirely concordant results with this, owing to the friction of the mica developing electricity on the inner surface of the glass tube; but in all cases, when the cylinder was raised until it covered the electrified

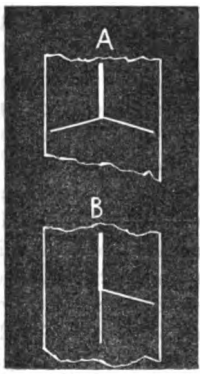

FIG. 4A.

leaves, it had the effect of diminishing the angle which they formed with each other.

The following experiments were also tried. The leaves being separated about 160°, as at fig. 4A, one side of the tube was slightly heated by a spirit flame. The leaf on that side fell to a vertical position, and remained so when all was cold, the other leaf sticking out as before, as at B. This seems to show that the divergence of the leaves in this case was not so much

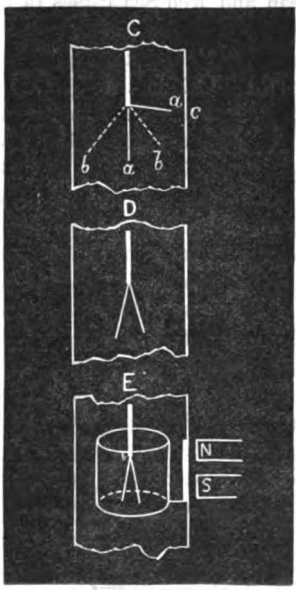

FIG. 4.

due to their mutual repulsion, as to an attraction exerted on each of them by the inner surface of the glass tube. The remaining divergent leaf could be slightly lowered when the glass tube above it was warmed with a bunch of cotton wool dipped in hot water. On cooling, the leaf rose again to its original position. When this side of the tube was also heated

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with a lamp, the leaf was repelled down, but not so readily as the other had been, and when the tube got cold, it rose to nearly its former position. This was repeated several times with uniform results. When the leaf was repelled down, the vertical leaf also moved away, so as to keep the same angle between them. This shows that the leaves themselves were also charged.

Fig. 4, C. shows the two positions of the leaves, *a a* before applying heat to the side *c* of the tube, and *b b* after heating the glass at *c*.

The tube was now heated on both sides, causing the leaves to come nearer together, as shown at fig. 4, D. While the glass was warm the cylinder was raised so that it surrounded the leaves; this caused them to get a little closer together, and they kept in this position, shown at E, till the whole apparatus was quite cold.

After remaining thus for some time, the cylinder was lowered, when the leaves widened out and took up the position shown at *b b*, fig. 4, C. The leaves did not return to the position *a a*, showing that now their divergence was owing to their own mutual repulsion, and not to an attraction of one or other to the electrified glass.

In December, 1877, I totally immersed one of these exhausted glass bulbs in a vessel of water; the gold leaves having previously been charged, and standing at an angle of 112° from one another, as at fig. 5. The

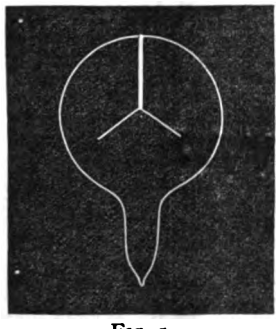

FIG 5.

water was connected electrically with "earth," and the whole was set aside in a cabinet on the 1st of January, 1878.

At the present time, after having remained in this condition for thirteen months, the leaves form exactly the same angle with one another which they did when they were first put in the cabinet.

After this experience I think we may consider that at an exhaustion of a millionth of an atmosphere, air is an absolute non-conductor of statical electricity. It is, therefore, legitimate to conclude that the vacuum of interstellar space offers equal obstruction to the discharge of electrified bodies, without necessarily interfering with their mutual repulsion if similarly electrified. It is possible that in these facts an explanation may be found of some obscure celestial phenomena.

GOWER'S TELEPHONE.

THE chief and generally acknowledged defect from which the telephone suffers is the still small voice in which it delivers its utterances, the listener being obliged to place the telephone close against his ear, bawl the speaker never so loudly. What we want is a telephone capable of so modulating its voice as to be able, when desired, of giving out the messages entrusted to it either *sotto voice* or in a tone audible to a number of persons at once, a result which, gushing journalism notwithstanding, has not yet been achieved.

It is therefore with considerable satisfaction that we hail the improvements effected by Mr. Gower, of Paris, as a step in the right direction; for although the telephone he has produced does not quite come up to the above-mentioned standard, it is nevertheless the best telephone we have yet heard.

Associated with Professor Bell in the birth of the telephone in America, Mr. Gower has followed it up through the various stages of its evolution, the instrument here described being the result of long and careful experiment.

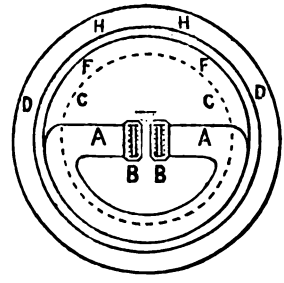

FIG. 1.

Fig. 1 shows the internal arrangement, in which AA is the magnet, BB the coils, DD the box, FF interior circumference of box, H H exterior circumference. This box is sometimes of wood, sometimes of copper; in the latter case the thickness is less than that shown. The dotted circle C C shows the position of the

FIG. 2.

diaphragm, removed to show the magnet. The dotted line E shows the position of the whistle described below.

It will be seen that although the magnet occupies but a small space, its disposition produces a very powerful magnetic field (after an idea borrowed from Faraday). The diaphragm employed is much

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thicker than that of the ordinary telephones, and is of course much larger. A flexible speaking-tube (fig. 2) attached to the case of the instrument allows the speaker to have the telephone fixed in any convenient position on a table or against a wall, and to talk to it without leaving his seat.

One notable feature in the new telephone is the call arrangement. This consists simply of a reed (harmonium or concertina form), beds and batteries being dispensed with. An oblong aperture cut in the diaphragm, while in no way affecting the talking power of the instrument, allows a sharp puff of air sent into the tube to pass through and agitate the reed-tongue; a sound resembling that from a toy-trumpet being produced at the receiving end loud enough to call attention in any part of the room in which the instrument is situate.

In the exhibition of Mr. Gower's telephone recently made by M. du Moncel, at the Académie des Sciences and the French Physical Society, the instrument was so delicately adjusted that it was possible, by the application of large funnels in place of the ordinary mouthpiece, to cause words imparted at the sending end to be audible several yards from the receiving telephone.

We expect to hear more of this instrument yet.

COWPER'S TELEGRAPHIC PEN.

ANOTHER telegraphic marvel was brought to the notice of the world on Wednesday last, at the meeting of the Society of Telegraph Engineers, by its inventor Mr. E. A. Cowper, the well-known engineer. Cowper's Telegraphic Pen is the first literal telegraph, and as the telephone permits any person to converse by wire, so this supplementary invention enables any one to write by wire. We recently gave an account of D'Arlincourt's autographic apparatus (see TELEGRAPHIC JOURNAL, January 15th) by which a similar purpose is effected in a roundabout fashion, little thinking then that that beautiful but complex instrument was destined to be eclipsed by the simple and versatile telegraphic pen of Mr. Cowper.

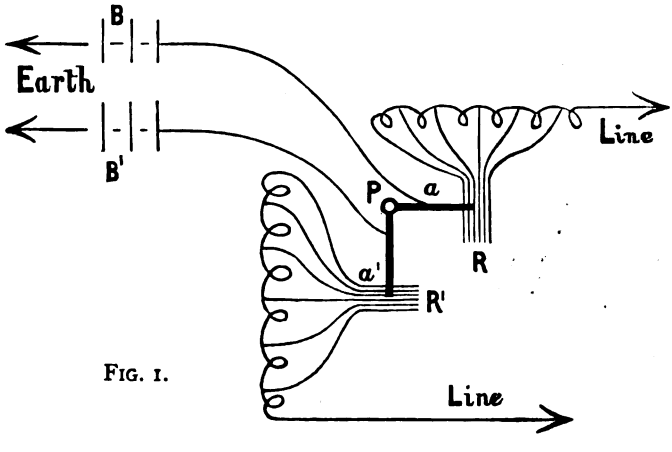

FIG. 1.

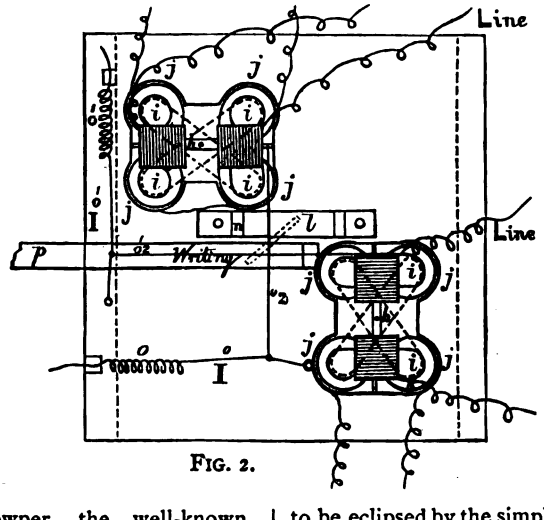

FIG. 2.

In designing his pen Mr. Cowper was guided by the principle that all points in a curve can be determined by the perpendicular length of two lines

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drawn from fixed co-ordinates at right angles to each other, just as the track of a ship is laid down on a chart by its latitudes and longitudes. Every point in a line of writing therefore can be determined by its distance from such fixed lines, every stroke of the writing pencil or pen can be resolved into horizontal and vertical components. It follows that if these components could be transmitted by wire continuously as the writing is being done, and recombined at the receiving end on a pen or pencil there, the latter would reproduce the original writing. It is this feat which Mr. Cowper has accomplished.

He employs for the purpose two separate circuits, one to transmit the up and down range of the pen, and the other the sidelong range. Each circuit consists of a battery, a set of variable resistances and the line, and for the sake of explanation it will be sufficient to consider any one of these, say that which transmits the up and down range of the sending style. Fig 1 represents in theory the connections for sending a written message, P is the pencil which the writer takes in his hand and writes with in the ordinary manner; the paper being pulled by clockwork slowly under the point. A metal arm *a*, fitted at its point with a contact piece, is attached to P, and the working pole of the battery is connected to *a*. Between the arm *a* and the line, there is inserted a series of resistance coils R, whose contacts or poles are thin metal plates, placed edgewise, and insulated from each other by sheets of paraffined paper. There are thirty-two of these coils and plates. Now the arm *a* is so connected to the pencil P that as the latter writes the arm moves lengthwise, that is in the direction of its axis, across the edges of the resistances R to an extent equal (or it may be proportional) to the vertical range of the pencil. By pushing across these resistances in this manner it puts in or takes out of circuit a number of the resistances proportional to the extent of its movement. Hence the strength of the current in circuit is varied according to the vertical range of the pen. Similarly in the other circuit provided for the transmission of the side-long motion, the arm a^1 slides over the resistances R^1 and puts in or takes out resistances which vary the strength of the current according to the direct sidelong motion of the pencil. It will be understood that the actual movement of the pen is very slight, being comprised within the dimensions of any single letter formed, for the movement of the paper itself obviates the necessity of the pen shifting from letter to letter.

The receiving apparatus is sketched in fig. 2. It consists for each line of two hollow galvanometer coils *i i*, with a needle *h*, pivoted so as to present its poles within their interiors. Four electro-magnets *j j j j*, which, however, might be permanent magnets, are placed underneath to control the zero of the needle. From one end of this needle a fibre leads to the writing pen, which is a fine glass siphon *k*, drawing off aniline ink from a small well. This fibre o_2, is kept taut by being tied to the cross fibre o_1, which is stretched by the spring *o*. For the other circuit there is a similar galvanometer arrangement with a thread o_2^1, kept taut by the thread o_1^1 and the spring o^1. Now when the current from each line passes through its proper galvanometer, by the wires shown, the needles move to degrees corresponding to the strength of the currents flowing, and, therefore, approximately to the ranges of the writing pencil at the sending station. By the cross fibres these two motions are combined on the siphon, and the latter inscribes the letters of the message on a moving slip of paper *p*. This copy may be either larger, smaller, or of the same size as the original writing. The advantages of Cowper's Writing Telegraph are obvious on a little reflection. It will supplement the telephone in business by giving *written* orders; or it will be useful in the field as a copying telegraph, while for private and confidential purposes, it will be valuable, since any unskilled person may use it, and secret marks may readily be sent.

MEASURING AND REGULATING ELECTRIC CURRENTS.

By C. WILLIAM SIEMENS, D.C.L., F.R.S.

THE dynamo-electric machine furnishes us with a means of producing electric currents of great magnitude, and it has become a matter of importance to measure and regulate the proportionate amount of current that shall be permitted to flow through any branch circuit, especially in such applications as the distribution of light and mechanical force.

On the 19th June last, upon the occasion of the Soirée of the President of the Royal Society, I exhibited a first conception of an arrangement for regulating such currents, which I have since worked out into a practical form. At the same time, I have been able to realise a method by which currents passing through a circuit, or branch circuit, are measured, and graphically recorded.

It is well known that when an electric current passes through a conductor, heat is generated, which, according to Joule, is proportionate in amount to the resistance of the conductor, and to the square of the current which passes through it in a unit of time, or

$$H = C^2R.$$

I propose to take advantage of this well-established law of electro-dynamics, in order to limit and determine the amount of current passing through a circuit, and the apparatus I employ for this purpose is represented in figs. 1 to 3 of the accompanying drawings. Letters of reference to the principal parts of the instrument are given in fig. 1.

The most essential part of the instrument is a strip (A) of copper, iron, or other metal, rolled extremely thin, through which the current to be regulated has to pass. One end of this thin strip of metal is attached to a screw (B), by which its tension can be regulated; it then passes upwards over an elevated insulated pulley (I), and down again to the end of a short lever, working on an axis, armed with a counter-weight and with a lever (L), whose angular position will be materially affected by any small elongation of the strip that may take place from any cause. The apparatus further consists of a number of prisms of metal (P), supported by means of metallic springs (M), so regulated by moveable weights (W) as to insure the equidistant position of each prism from its

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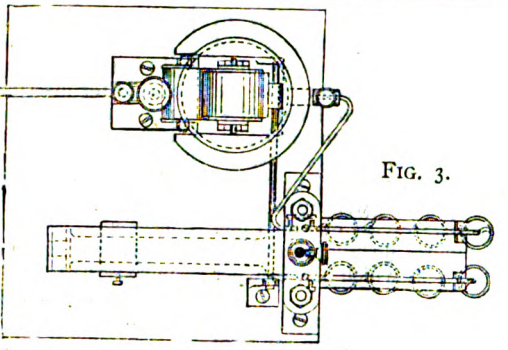

FIG. 3.

A.—*Sensitive strip.*
B.—*Tension screw.*
L.—*Lever.*
M.—*Metal springs.*
I.—*Insulated pulley.*
W.—*Adjusting weights.*
P.—*Contact prisms.*
S.—*Contact spring.*
T.—*Terminal.*
R.—*Resistance coils.*

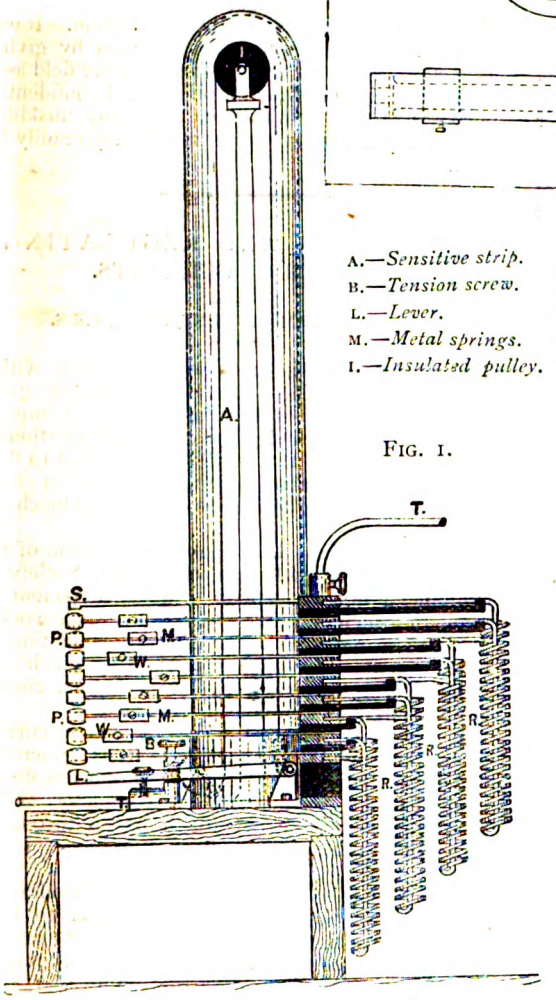

FIG. 1.

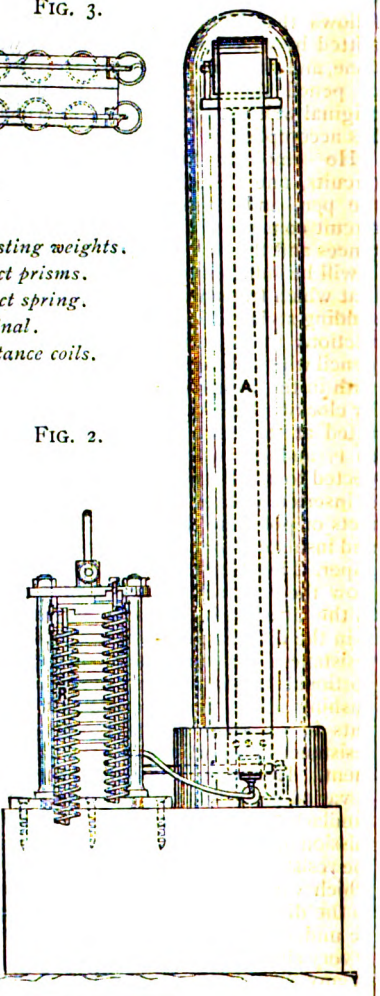

FIG. 2.

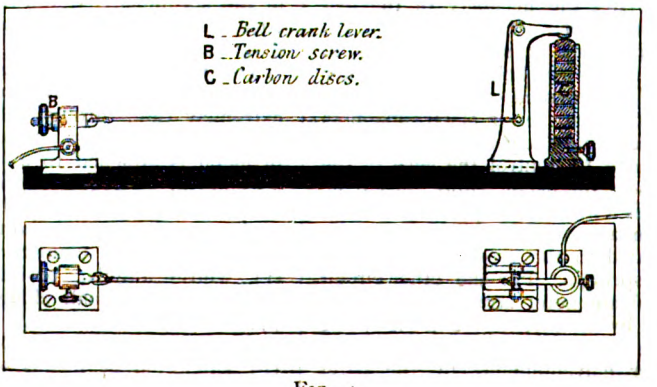

FIG. 4.

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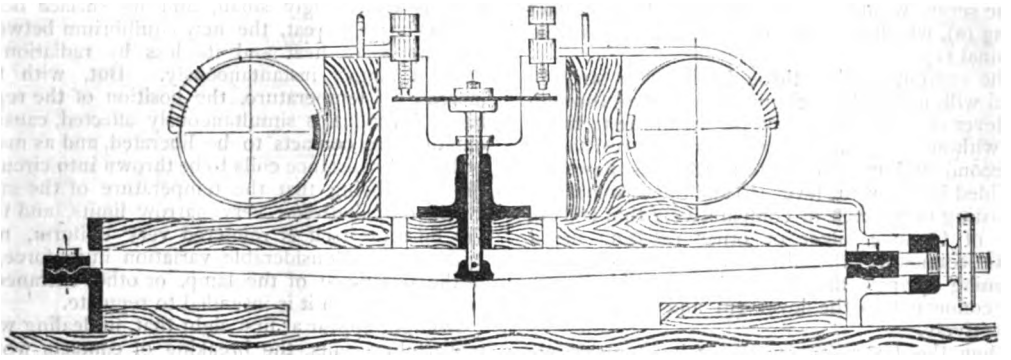

FIG. 5.

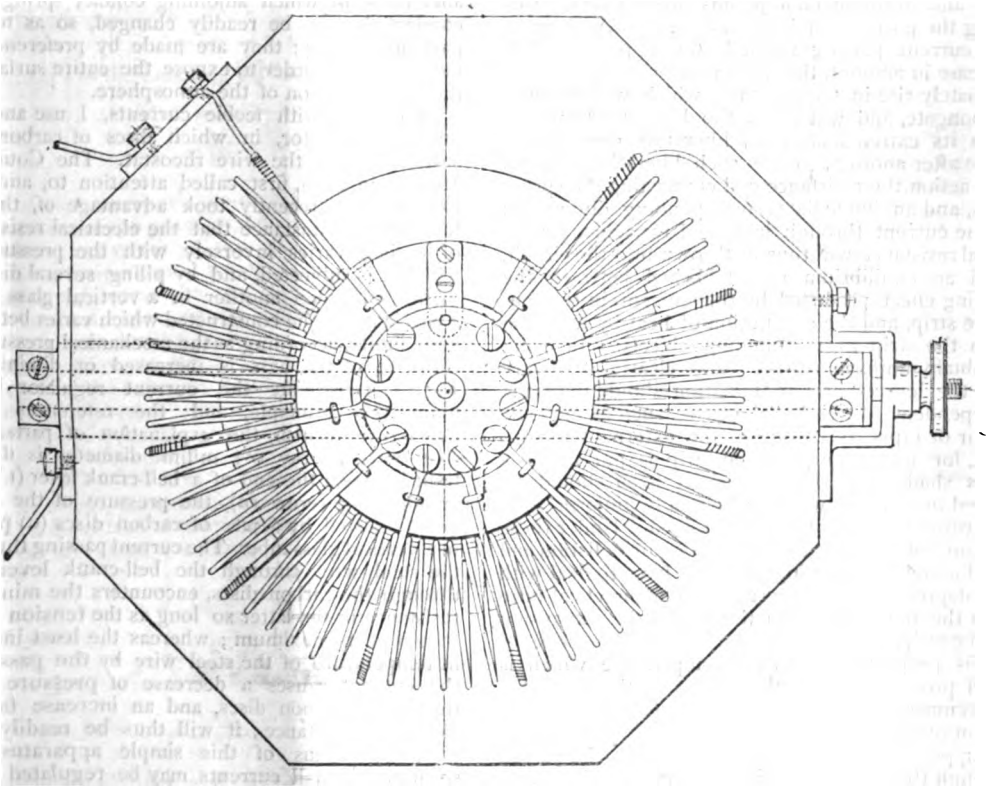

FIG. 6.

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neighbour, unless pressed against the neighbouring piece by the action of the lever (L), in consequence of a shortening of the metallic strip. By this action, one prism after another would be brought into contact with its neighbour, until the last prism in the series would be pressed against the contact spring (S), which is in metallic connexion with the terminal (T).

The current passing through the thin strip of metal will, under these circumstances, pass through the lever (L) and the line of prisms to the terminal (T), without encountering any sensible resistance. A second and more circuitous route is, however, provided between the lever (L) and the terminal (T), consisting of a series of comparatively thin coils of wire of German silver or other resisting metal (R, R), connecting the alternate ends of each two adjoining springs, the first and last spring being also connected to the lever (L) and terminal (T) respectively.

When the lever (L) stands in its one extreme position, as shown in the drawing, the contact pieces are all separate, and the current has to pass through the entire series of coils, which present sufficient aggregate resistance to prevent the current from exceeding the desired limit.

When the minimum current is passing, the thin metallic strip is at its minimum working temperature, and all the metallic prisms are in contact, this being the position of least resistance. As soon as the current passing through the apparatus shall increase in amount, the thin metallic strip will immediately rise in temperature, which will cause it to elongate, and will allow the lever (L) to recede from its extreme position, liberating one contact piece after another. Each such liberation will call into action the resistance coil connecting the spring ends, and an immediate corresponding diminution of the current through increased resistance; additional resistance will thus be thrown into the circuit, until an equilibrium is established between the heating effect produced by the current in the sensitive strip, and the diminution of heat by radiation from the strip to surrounding objects. In order to obtain uniform results, it is clearly necessary that the loss of heat by radiation should be made independent of accidental causes, such as currents of air or rapid variations of the external temperature, for which purpose the strip is put under a glass shade, and the instrument itself should be placed in a room where a tolerably uniform temperature of say 15° C. is maintained. Under these circumstances, the rate of dissipation by radiation and conduction (considering that we have to deal with low degrees of heat) increases in arithmetical ratio with the temperature of the strip; the expansion of the strip, which effects the position of the lever (L), is proportionate to the temperature which is itself proportionate to the square of the current—a circumstance highly favourable to the sensitive action of the instrument.

Suppose that the current intended to be passed through the instrument is capable of maintaining the sensitive strip at a temperature of say 60° C., and that a sudden increase of current takes place in consequence either of an augmentation of the supply of electricity or of a change in the extraneous resistance to be overcome, the result will be an augmentation of temperature, which will continue until a new equilibrium between the heat supplied and that lost by radiation is effected. If the strip is made of metal of high conductivity, such as copper or silver, and is rolled down to a thickness not exceeding 0·05 milim., its capacity for heat is exceedingly small, and its surface being relatively very great, the new equilibrium between the supply of heat and its loss by radiation is effected almost instantaneously. But, with the increase of temperature, the position of the regulating lever (L) is simultaneously affected, causing one or more contacts to be liberated, and as many additional resistance coils to be thrown into circuit: the result being that the temperature of the strip varies only between very narrow limits, and that the current itself is rendered very uniform, notwithstanding considerable variation in its force, or in the resistance of the lamp, or other extraneous resistance which it is intended to regulate.

It might appear at first sight that, in dealing with powerful currents, the breaking of contacts would cause serious inconvenience in consequence of the discharge of extra current between the points of contact. But no such discharges of any importance actually take place, because the metallic continuity of the circuit is never broken, and each contact serves only to diminish to some extent the resistance of the regulating rheostat. The resistance coils, by which adjoining contact springs are connected, may be readily changed, so as to suit particular cases; they are made by preference of naked wire, in order to expose the entire surface to the cooling action of the atmosphere.

In dealing with feeble currents, I use another form of regulator, in which discs of carbon are substituted for the wire rheostat. The Count du Moncel, in 1856, first called attention to, and Mr. Edison more recently took advantage of, the interesting circumstance that the electrical resistance of carbon varies inversely with the pressure to which it is subjected, and by piling several discs of carbon one upon another in a vertical glass tube, a rheostat may be constructed which varies between wide limits, according as the mechanical pressure in the line of the axis is increased or diminished. Fig. 4 represents the current regulator based upon this principle, and the references upon the figure furnish the explanation of parts. A steel wire of say 0·3 milim. diameter is drawn tight between the end of a bell-crank lever (L) and an adjusting screw (B), the pressure of the lever being resisted by a pile of carbon discs (C) placed in a vertical glass tube. The current passing through the steel wire, through the bell-crank lever, and through the carbon discs, encounters the minimum resistance in the latter so long as the tension of the wire is at its maximum; whereas the least increase in temperature of the steel wire by the passage of the current causes a decrease of pressure upon the pile of carbon discs, and an increase in their electrical resistance; it will thus be readily seen that, by means of this simple apparatus, the strength of small currents may be regulated so as to vary only within certain narrow limits.

The apparatus described in figs. 1 to 3 may be adapted also for *measurement* of powerful electric currents. The variable rheostat is in this case dispensed with, and the lever (L) carries at its end a pencil, pressing with its point upon

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a strip of paper drawn under it in a parallel direction with the lever by means of clockwork. A second fixed pencil draws a second or datum line upon the strip, so adjusted that the lines drawn by the two pencils coincide when no current is passing through the sensitive strip. The passage of a current through the strip immediately causes the pencil attached to the lever to move away from the datum line, and the distance between the two lines represents the temperature of the strip. This temperature depends, in the first place, upon the amount of current passing through the strip, and, in the second place, upon the loss of heat by radiation from the strip; which two quantities balance one another during any interval that the current remains constant.

If C is the current before increase of temperature has taken place; R the resistance of the conductor at the external temperature (T); H the heat generated per unit of time at the commencement of the flow;

R′ the resistance, and H′ the heat, when the temperature T′ and the current C′ have been attained.

Then, by the law of Joule,

$$H' = R' C'^2.$$

But inasmuch as the radiation during the interval of constant current and temperature is equal to the supply of heat during the same interval, we have, by the law of Dulong and Petit,

$$H' = (T' - T)\, S,$$

in which S is the radiating surface. Then

$$R' C'^2 = (T' - T)\, S$$

$$C'^2 = (T' - T)\, \frac{S}{R'}.$$

But T′ — T represents the expansion of the strip, or movement of the pencil *m*, and considering that the electrical resistance of the conductor varies as its absolute temperature (which upon the Centigrade scale is 274° below the zero Centigrade) according to a law first expressed by Helmholtz, and that we are only here dealing with a few degrees difference of temperature, no sensible error will be committed in putting the value of R for R′, and we have the condition of equilibrium

$$C'^2 = m \frac{S}{R} \quad \therefore C' = \sqrt{m \frac{S}{R}}, \quad (1)$$

or, in words, the current varies as the square root of the difference of temperature or ordinates.

For any other condition of temperature T″ we have

$$C''^2 = \frac{S}{R} (T'' - T)$$

$$\therefore C'' = \sqrt{\frac{S}{R} (T'' - T)}:$$

and

$$(C''^2 - C'^2) = (T'' - T - T' + T) \frac{S}{R} = (T'' - T') \frac{S}{R},$$

but for small differences of C″ and C′ we may put

$$(C''^2 - C'^2) = 2\, C'' (C'' - C'),$$

that is to say, small variations of current will be proportional to the variation in the temperature of the strip.

In order to facilitate the process of determining the value of a diagram in Webers or other units of current, it is only necessary, if the variations are not excessive, to average the ordinates, and to determine their value by equation (1), or from a table prepared for that purpose. The error committed in taking the average ordinate instead of the absolute ordinates, when the current varies between small limits, is evidently small, the variation of the ordinates above their mean value averaging the variations below the same.

The thin sensitive conductor may thus be utilised either to restrict the amount of electricity flowing through a branch circuit, within certain narrow limits, or to produce a record of the amount of current passed through a circuit in any given time.

[A newer form of Regulator than that illustrated above was shown by Dr. Siemens at the meeting of the Physical Society on February 22nd. In this form, which is shewn in plan and section in figs. 5 and 6, the fine steel strip $\frac{1}{20}$th millimetre in diameter, into which the current passes, is horizontal. A short spindle rests upon the middle of the strip by means of an insulating foot, and carries at its top a crown of radial springs, or it may be a circular plate. This spindle, with its crown of springs, is encircled by a helix of German-silver wire in the form of a ring. From certain fixed points in this helix, springs project, and these points are so depressed that, as the spindle rises to less or greater heights, one or more of the coils of the helix are thrown out of the circuit of the current by the spindle springs making contact with the coil springs. On the other hand, when the spindle sinks by the expansion of the strip, due to an increase of current, one or more coils of the helix are thrown into circuit. This new Regulator is an improvement on the older form, the pendulous contacts of which were apt to get dirty and interfere with its working.—ED. T. J.]

A NEW DUPLEX SYSTEM.

By S. M. BANKER.

As the method by which our duplex circuits are to be worked with as much ease and as little trouble to the telegraphist as an ordinary simplex Morse, notwithstanding the variations of our lines due to the climate, has not yet been invented, or if invented the fortunate inventor has not made it known, I have no doubt that the following method of working a duplex circuit may be interesting to many, as another solution of the problem without putting forward the least claim to any superiority over the differential system.

It consists of a specially constructed relay and a continuity preserving key besides the battery and Morse or Sounder.

On glancing at the accompanying fig. it will be seen that the relay is constructed of two coils A B, distinct and separate from each other. One, B, is fixed to the base of relay, whilst the other, A, is moveable by means of a rack and pinion R at right angles to the tongue of relay T. Each core of the

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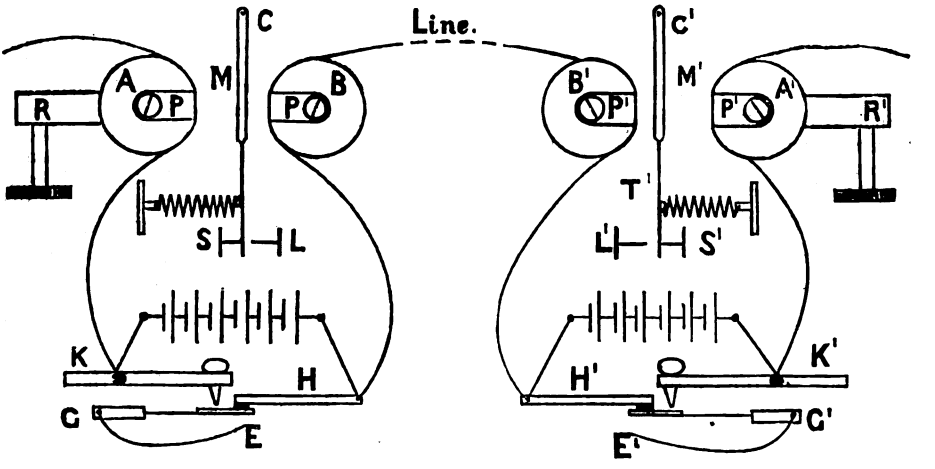
coils is prolonged top and bottom by pole pieces P turned towards each other, between which the permanent magnet M moves. This magnet is of horse-shoe form, pivoted top and bottom at C with the legs between the coils, the upper leg of the magnet being lengthened, forming the tongue T for completing the local recording circuit at L and also giving a convenient point for attaching a spiral spring at S.

The key is a modification of the one originally invented by Nystrom, in which the lever K being pressed down moves the spring G off the contact H, so that the contact between G and K is made before the contact between G and H has been broken, thereby preventing any disconnection in the circuit.

This duplex is worked by the system of the current only going through one coil of the relay at a time from the sending station, and is accomplished by joining a pole of the battery, say copper, to the contact H of key and thence to line through the coil

The stations adjust their own apparatus independently of each other, commencing by putting a piece of paper between contact H and G of key, pressing down lever K, putting current on line through B at same time increasing the tension of spring S until it just pulls the tongue of relay of local contact L, then prove the balance by sending dots rapidly. Now remove the piece of paper from between contacts H and G, allowing the current to pass through coil A to earth, and move the coil A by means of the rack and pinion until it just moves the tongue of relay T off the local circuit contact L. If these two operations have been performed correctly the working of the key does not affect the relay, and the relay is now in such a position that a very slight current coming from the line and traversing the coil so as to increase the magnetic effect of that coil will throw the tongue of relay over to the local contact L.



B in such a direction that the magnet M is attracted when the spiral spring S is loose; then the other pole, zinc, is attached to lever of key K, and so to earth through the coil A, passing round the core in the same direction as in B, producing in the electro-magnets opposite polarity and causing a pull on the magnet M always in the same direction. The spring G is joined to earth.

As this system compels the stations to work with assisting currents, it will be readily seen that the relay of one station responds to the movements of the key of the other station, whether the first station is sending or not. Further, the point of changing the battery from one coil to the other is so short by the arrangement of the key that it does not affect the signals.

REPORT ON ELECTRIC LIGHT EXPERIMENTS.

BY LOUIS SCHWENDLER.

(*Continued from page* 48.)

ON SOME OF THE SCIENTIFIC RESULTS OBTAINED BY EXPERIMENT.

AT the commencement of this part of his report, Mr. Schwendler states that the units adopted have been those founded on the *Centimetre-Gramme-Second* system; Mr. Schwendler, however, employs the Siemens' unit of resistance throughout his report, although this unit is not based on the system referred to. The currents were measured by means of a tangent galvanometer, constructed in a special manner to suit the particular purpose; by its means all the currents between 1·6 to 38 Webers could be measured to an accuracy of 3 per cent. *at least.*

The Photometer for measuring the intensity of the light was constructed on the following principle:—

Two surfaces, equal in size and nature, were placed side by side, quite close together, and in the same plane.

One surface was illuminated by one light, the other surface by the other light, two equal flint-glass prisms being employed for the purpose.

The surfaces towards the eye were covered with

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tracing paper, the top half of each paper being divided by fine pencil lines into small squares.

The equalisation of the intensities of the two lights under comparison was done by keeping the distance between the two lights *constant*, and moving the two illuminated surfaces *within* the constant distance.

This photometer is particularly well adapted for comparing the intensities of two differently coloured lights, as an experienced eye can easily distinguish the relative distinction between the pencil lines and the back ground of each surface, and if this relative distinction is the same in both surfaces, the two surfaces have equal intensity, no matter what the colour of each light may be. However, as a rule, the comparison of any two lights, was made by observing the two surfaces through a *red glass*. This glass, after trying a great variety of glasses, was found to have the convenient quality of making the colours of the electric light and of the standard light equal.

It was ascertained that this red glass absorbed all the violet, blue, and green rays, letting through only some yellow, more orange, and all the red; hence, if two lights under comparison contain the different coloured rays in different proportions, it may be said that by adjusting balance by means of the red glass, the ratio must become erroneous; however, actual experiments proved that this was practically not the case. If there was a difference it was quite within the limits of errors caused by the considerable variation in the intensity of electric lights.

Two electric lights compared with each other by means of the red glass and without it, gave practically the same ratio, and, further, the same electric lights compared each with a standard light gave a ratio sufficiently close to the one found by direct comparison of the two electric lights.

The Dynamometer employed to measure the transmitting force was that invented by Mr. Hefner von Alteneck, of Berlin, and is based on the principle, that the strains on either side of a driving strap are unequal, and are proportional to the force transmitted, a well-known and long recognised fact.

The Measurement of the Speed of the machines was made by means of a *Pocket-Counter*, a *Mercury Speed Indicator* by J. M. Napier, and a *Cycloscope*, an invention of Lieut. G. S. Clarke, R.E., and Professor McLeod. The principle of the cycloscope consists in employing a tuning fork or reed as the standard by which to measure velocities of rotation.

The *resistance measurements* were made by means of an ordinary Wheatstone bridge with Siemens' units.

The *Standards of Light* employed were:—the *Standard Candle* and the *Platinum Light Standard*; this latter standard being the light emitted from a piece of pure platinum weighing *(x)* Gm, and having the most convenient shape and size, when a constant current of *(y)* Webers passes through it. This standard produces a light of perfect constancy, so long as the current is kept constant, and further allows a correction to be made if the variation of the current is known.

RESULTS.

It was found that the standard candle, in order to produce the unit of light, does work at the rate of 610 meg-ergs per second, *at the least*. Further, by direct experiment, it was ascertained that the unit of light, as produced in an electric arc, by any one of the dynamo-electric machines under trial, and through a leading wire offering not more than 0·1 S.U. resistance, is produced at the rate of not more than 20 meg-ergs per second, including *all the work transmitted*, and the light measured in a line which passes through the centre of the arc, and stands normal to its axis. Hence the probable engineering margin in favour of the electric light is between 30 to 70, or equal to a mean of 50.

Dynamo-electric machine A produced the unit of light at a rate of not more than 10 meg-ergs per second.

Hence it may be safely asserted that the electric light produced by dynamo-electric machines is on an average 50 times cheaper than light by combustion. This is, however, true only as long as the light is produced in *one* arc.

The dynamo-electric machine with the greatest number of sections in the induction cylinder gives the steadiest current. Twelve sections were found *necessary* and *sufficient*.

The current produced by any dynamo-electric machine through a given constant total resistance in circuit, increases permanently with the speed of the induction cylinder. This increase of current for low speeds is more than proportional to the speed; afterwards it becomes proportional; and for high speeds the increase of current is less than proportional to the speed. The current has, however, no maximum for any speed, but reaches it greatest value at an infinite speed.

Keeping the speed constant, the electro-motive force of any dynamo-electric machine decreases rapidly with increase of external resistance, and this decrease is more rapid, the smaller the internal resistance or the dynamo-electric machine is made. Hence the currents must decrease much more rapidly than proportional to the total resistance in circuit. And this being the case the external resistance in which the work of the current is done should invariably be made *smaller* than the internal resistance of dynamo-electric machines plus resistance of leading wires.

There appears to be no doubt that an appreciable opposing E. M. F. in the arc is established which acts in opposite direction to the electro-motive force of the dynamo-electric machine, and this E. M. F. of the arc *increases* with the current, passing through the arc; also, the resistance of the arc for constant length is also a function of the current passing through it, *i. e.*, the resistance of the arc *decreases* with the current.

A comparison of the efficiency of the machines tried showed that the dynamo-electric machine A converts 62% of the total energy transmitted into useful work, while 38% is lost in heating the machine. Dynamo-electric machine D converts 30% of the total energy transmitted into useful work, and loses 70% in heating its own wires.

Above 24 Webers, the different dynamo-electric machines produce the Weber at the following consumption of power:—

Dynamo-electric machines A & B	produces *one* Weber at 686·5 meg-ergs per second.
Dynamo-electric machine C	produces *one* Weber at 736 meg-ergs per second.
Dynamo-electric machine D	produces *one* Weber at 920 meg-ergs per second.

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As regards the *Regularity of the Electric Light*, it was found that if the resistance external to the Dynamo-Electric Machine is represented by the resistance of the arc only, *i. e.*, resistance of leading wires equal "Nil," then although the light is naturally the most powerful, it is the least steady, since any variation of the resistance of the arc has then evidently the largest influence on the current and on the light.

By connecting across the electro-magnet of an electric lamp, another electro-magnet, which acts as a shunt, and adjusting the two electro-magnets in such a manner that they produce *equal extra currents* when variations in the primary current take place, the regularity of the working of the lamp can be greatly enhanced. An electro-static shunt will have a similar effect. For *strong lights* or *strong currents*, the electro-magnetic shunt is best; for *weak lights* or *weak currents* the electro-static shunt is best.

When making photometric measurements, to get more trustworthy results, it was found best to use *a carbon* (2 to 3 mm. thick) as the positive electrode, and a carbon of the usual form as the negative electrode, the light being observed in a line normal to the flat surface of upper carbon, and passing through the centre of the arc. In this manner the largest quantity of *total light* produced is measured, and, moreover, the ratio between *total* and *external* light is more constant.

The lower carbon should be invariably of less section than the upper carbon, and further, when producing the light by a short arc, which it is always advisable to do, the lower carbon should be *natural* carbon. Coppering the carbon is advisable under all circumstances.

The hissing noise produced by the electric arc is much stronger in a short than in a long arc, and in either case the noise in a quiet room is simply unbearable.

The light permanently decreases with length of arc, hence the arc should be made as short as possible. As this would, however, be bad for the constancy of the light, and may also spoil the dynamo-electric machine, the commutator of the latter should be adjusted by turning the brushes in the direction of the rotation until only small sparks are observed.

Although the light produced in the arc must be very nearly proportional to the total energy consumed in the arc (minus the energy expended in giving the disintegrated carbon particles velocity), the resistance of the arc decreasing with increase of current, it follows that the light *cannot* be proportional to the square of the current. If we make the highly probable supposition that the resistance of an arc of constant length is inversely proportional to the current which passes through, then the light produced would be proportional to the current. This appears to be the case.

DEATH.—Dr. Heinrich Geissler, the inventor of Geissler's tubes, died at Bonn, Germany, on Jan. 24. He began life as a glass-blower, and after some years of wandering, settled down as a glass-blower to the University of Bonn, where he won a world-wide reputation.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

CLERAC'S TUBE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In Nos. 143 and 144 of the TELEGRAPHIC JOURNAL, pages 29 and 49, my name is used in such a way as to place upon me the duty of clearly explaining to the readers of the Journal the true facts which are treated of.

Firstly, in a report upon the Historical Section of the German Telegraph Exhibition, printed in the International Exhibition Journal in 1873, and republished in the *Journal Telegraphique*, Vol. II., Nos. 24 to 26, I have affirmed, according to the *Official Catalogue* on the objects exhibited by the Imperial German Telegraph Administration, that since 1865 resistances of pulverised graphite have been ordinarily used in way stations for regulation of resistances. Thereupon, in No. 27 of the *Journal Telegraphique*, page 425, the invention of powdered carbon resistances was claimed for M. Clerac in the form already cited by Mr. Barrett in page 50 of the TELEGRAPHIC JOURNAL. In my short abstract of the "History of the Electric Telegraph," page 69, and in my "Handbook of Electric Telegraphy," Vol. I., page 518, I have certainly mentioned M. Clerac's claim; but, giving at the same time my sources of information, I adhered to my former assertion and have also referred to older experiments with graphite resistances.

Secondly, Professor Hughes *was therefore mistaken* when he wrote that since then the priority has been freely accorded to M. Clerac. This compelled me to make a correction in the *Journal Telegraphique*, Vol. IV., page 238.

Thirdly, instead of adducing proof of the unreliability of my source, M. Clerac thereupon, in the *Journal Telegraphique*, Vol. IV., page 260, desired of me that I should give the name of the inventor of powered carbon resistance.

Fourthly, Professor Hughes now goes still further, and requires me (TELEGRAPHIC JOURNAL, page 29) to prove that I knew and used powdered graphite resistances before 1866, but, that I have ever at any time, or anywhere, affirmed *this*, is simply not the case.

Fifthly, and lastly, the distinguished M. Du Moncel completely crushes me (TELEGRAPHIC JOURNAL, page 49) by denouncing me as a Prussian, doubtless at the same time with a view to air his profound geographical knowledge. Unfortunately, this gross and groundless calumny now lacks the charm of novelty. It resembles in appearance some earlier and quite baseless aspersions of the Count, which I thought to have duly and finally disposed of in Note 1, page 538, of Vol. I. of my "Handbook."

While I naturally have nothing further to say under the heads of fourthly and fifthly, I content myself once for all with reference to No. 3, by repeating the conclusion of my explanation already made on Feb 1, of this year, to the editor of the *Journal Telegraphique*: "I believe I may, for the present at least, decline to go farther into the question as to the inventor or inventors of powdered carbon resistances, although M. Clerac sets me this task. The question is indeed of very minor importance, for, on the one hand, powdered carbon resistances, on account of their unreliability, have already long ceased to be used in telegraphy, and, on the other hand, the name of the inventor of powdered carbon resistances is also quite without significance for

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decision of the question whether or not the adjustment of these resistances to a certain value by pressure screws includes the knowledge and demonstration that the compression of such extremely short duration produced by vibrating bodies are capable of causing so great and constant variations of the current as the microphone requires."

EDWARD ZETZSCHE,
Professor of Telegraphy in the Royal Polytechnic College, Dresden.

Dresden, *Feb.* 17, 1879.

[It is due to Count Du Moncel and to Professor Zetzsche to state that the Count, after penning his letter, printed in our last, subsequently wrote us, asking that the reference to Professor Zetzsche in it should be wholly withdrawn. We should have been very glad to do so, but had, unfortunately, gone to press before the Count's note reached us.—ED. T. J.]

SIR,—In my former communication to your Journal I stated that having made diligent search for any record of a carbon rheostat, involving the principle in dispute between Mr. Edison and M. Clerac, viz., variable resistance with variable pressure, I was unable to find such a record. On the contrary, I found in the *Journal Telegraphique*, of Berne, for 1874, a note which M. Clerac states was written by himself, wherein a rheostat is described composed of compressed carbon, no mention being made of variable pressure; in fact, separate tubes are referred to as constructed to give different, definite, and large resistances which were indicated.

At the same time I accepted unhesitatingly, on Professor Hughes' authority, the statement that M. Clerac had made a carbon rheostat, the pressure of which could be adjusted by a screw. The evidence now brought forward by Professor Hughes to show that a tube of this kind was made in 1865 or 1866 is conclusive, but it does not throw any light on the main points in dispute, which are simply these:—Where was a description of this variable pressure rheostat published, and through what range of resistance could it be made to vary? It is quite beside the mark to say that so many people have seen a tube containing plumbago with a screw at one end; this is not *publication*, and the screw, I suppose, in any case would have been a necessary adjunct to compress the plumbago within, just as a screw is usually fitted to dry piles to squeeze the discs together. I do not say this was the only object of the screw in Clerac's tube, but it seems highly probable that instructions would have been sent with the instrument as to the use of the screw if it were *specially* designed for the novel purpose of varying the pressure on the plumbago, and thereby adjusting the resistance. Hence, though a resistance tube having some resemblance to Edison's carbon rheostat was doubtless made by M. Clerac, the use now claimed for it was generally unknown; so much so that the Count du Moncel, the fellow citizen of M. Clerac, makes no mention of this tube in any edition of his truly admirable and complete "History of the Practical Applications of Electricity."

I am sorry if my esteemed friend Monsieur du Moncel does not think I have done sufficient justice to his researches on the effect of pressure on electric resistance: it was my sincere desire to do so, and if I have made any omission in this direction it has been unintentional, and I will gladly correct it. As I have said, again and again, there can be no doubt that the Count du Moncel first pointed out the effect of pressure on the electric resistance of solids, finely divided and otherwise.

The tone of M. Clerac's letter entirely forbids my having any discussion with that gentleman. If, instead of making offensive imputations, quite uncalled for, and unworthy of a scientific man, M. Clerac had simply pointed out any publication where an account is given of the use of the screw in adjusting the resistance of his tubes, it would have been a valuable contribution to the history of this subject; as it is, M. Clerac has added nothing but another brandishing shillelagh, of which we have had enough already. For my own part I think the entire subject has already received quite as much attention as your readers will care for.

Yours obediently,
W. F. BARRETT.

Royal College of Science,
Dublin, *February* 26.

GAS *v.* ELECTRICITY.

SIR,—My friend Mr. W. H. Preece has lately written an article under the above title, in which I think he does not do himself justice as an electrician, and perhaps I may be allowed to make a few observations upon it. He says:—"We know no more of the electric light now than we did in 1862, when as great a display was made in our Exhibition of that year as was made in the French Exhibition of last year." This, I think, is not quite correct. No one in 1862 ever dreamed of getting more than one light from one machine. I speak of the electric light proper, not an incandescent light produced by contact, where about three-fourths of the current is altogether lost. At that time the machines used were magneto-electric, producing their currents from permanent magnets. Since then, a new and very important class of machines has sprung up, and a dynamo-magneto machine can be made that will give a great number of lights in one circuit according as the machine is wound with large or small wire, and to the amount of power employed in driving the machine. Again, he speaks of a competitive trial of gas and electricity at the Clock Tower, Westminster. As I had something to do with the experiments, and took a great deal of interest in them, I am sure I am not wrong in saying that the electric light was preferred to the gas, but the reason of its not being adopted was because the Gramme patent was in the hands of gentlemen who knew absolutely nothing of the subject, and there was little or no prospect of ever getting a proper machine out of their hands, and I tried myself to get two machines from Paris for the purpose, but the English patent prevented it; and now, instead of having the pure, bright light of electricity, there are three gas furnaces one above another, and doubtless a large quantity of gas consumed. One other observation. In speaking of the multiplication of the light, Mr. Preece states that there is undoubtedly a loss of power in the distribution of the lamps. Now, the loss of power, if it does exist, is not appreciable as far as the Wallace machine is concerned, for we can obtain one light with 20lbs. steam, and as we go on increasing the steam pressure, we can increase the number of lights till at a pressure of 70lbs. we can get eight lights; but the most interesting feature is that, whether we run the machine for one or eight lights, the intensity of each light obtained is the same.

W. LADD.

11 and 12, Beak Street, Regent Street, W.
Feb. 8th, 1879.

THE JABLOCHKOFF ELECTRIC LIGHT.

SIR,—Permit me, as a subscriber to your Journal, to offer a few remarks on the article "Electric Light in Eclipse" in your issue of 15th inst., bearing on, as you call it, the failure of the Jablochkoff system.

The lighting electrically, as carried out by the Societé

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General of Paris, is the only method that has hitherto been on any thing like a large scale tested in England. The system is not, as stated, twice as expensive as any other; there is, I believe, very little, if any difference between actual cost of lighting by the various modes, and there is a wide margin between charge for a monopoly as at present existing, and cost with a fair profit, on a large scale, when adopted.

The Jablochkoff light at Billingsgate, on the river side and in the street, was a great success. Within the market itself the substitution of 15 electric candles for 1,100 gas jets was certainly unfavourable, and the pure white light no doubt displeased the vendors of fish, who, by its searching rays, were unable to make the creatures of the deep ought else than what they were.

At Westgate the lighting was undertaken by a gentleman, the proprietor, I understand, of the neighbouring gas works. The experiments were conducted without the assistance or supervision of any one connected with the Jablochkoff Company. On the introduction and trial, for as such it was intended, of a new mode of lighting, surely it was desirable and right that some one thoroughly understanding the subject should have attended to give advice. I see that all was properly worked out, as it was; the candles, which on the Thames Embankment and the Viaduct have never, for now many weeks, burned less than the one and a half hours, with the Westgate sometimes, have only spun out two-thirds of that time; also no tops or covers to the globes were used: in London such are necessary to protect from wind and rain, but in the stormy coast of North Kent, are seemingly unnecessary.

With such and other omissions in carrying out, experiment goes forth, and is extensively circulated; and your Journal endorses the word failure, surely without that proper enquiry which is advisable, in that fairness which I feel sure you desire to extend to all aspirants for the honour of partly illuminating our at present unlighted city. I enclose my card, and remain your obedient servant,

ELECTRODE.

Junior Carlton Club,
18th February, 1879.

[Our statement, to the effect that Jablochkoff's system is twice as expensive as its rivals, was made by Mr. Shoolbred to the Physical Society, on February 8, his estimate being taken from experiments in Paris. We have no wish but to be fair, and gladly publish our correspondent's letter. Trustworthy comparative experiments with different electric lights are much needed.—ED. T. J.]

A MICROPHONE RECEIVER.

SIR,—In trying some experiments some time ago, I was surprised to find that a metal lever resting on a metal point or block acted as a receiver when in circuit with a special transmitter and battery.

Acting on this I devised several receivers, but found that the best results were obtained when a sensitive low-resistance microphone was used. It is well known that the more sensitive we make a microphone of ordinary construction, the greater will be its resistance; and it is evident that if we wish to use two microphones in a circuit as transmitters and receivers, we will require a powerful battery.

I devised a microphone in which sound waves cause vibrations of a small diaphragm instead of acting on a carbon lever. A parchment diaphragm, about two inches in diameter, is fixed to a case somewhat similar to the mouthpiece of a telephone. A small block of carbon is glued to the centre of the diaphragm inside the case, and a carbon lever presses against the block. The lever and block are connected to binding screws on the outside of the case. This microphone is very sensitive and of very low resistance, as the contact between the carbons is good. I have tested every known form of microphone, and some devised by myself, but find the above is preferable for speaking, and for use on telephone lines, besides being more suitable as a receiver than other forms of microphones.

I believe sounds produced by microphones or variable resistance receivers, are due to variable vibrations caused by the current passing through the resistance of the carbons. In support of this theory, I may mention that the microphone when in circuit with a battery, sometimes "sing," making a similar noise to that produced by the telephone in circuit with a microphone and battery. These noises are sometimes as loud as the "singing noises" given out by the telephone, and it is evident that they must be caused by vibrations imparted to the parchment diaphragm by the current.

The "singing" noises of the telephone which have caused some surprise amongst many persons, may be explained in the same way.

Variable resistance receivers are not likely to come into practical use, as better results can be obtained with the telephone, and other magnetic receivers with a less amount of battery power. However, as an experiment, it is worth trying, and may lead to further discoveries in electrical science.

I observe that Prof. Hughes has constructed a variable resistance receiver, but I have not seen particulars of it, and believe that any one who uses the microphone I have described, will get more favourable results, with a less amount of battery power than would otherwise be necessary.

F. DOWLING.

A CARBON TRANSMITTER.

SIR,—To those interested in microphonic experiments I venture to suggest the following one—the outcome of which is the transmission of perfectly articulate speech, without any of the usual hissing sound produced by the microphone. Carbon powder reduced to a state of great fineness, is laid on a board, so as to form a disc about 1½ inches in diameter and one-sixteenth inch thick, into the opposite ends of any diameter of this disc, the terminals of a circuit, in which is a telephone and battery, are introduced to the depth of ¼ of an inch. The powder lies quite loose, and is subject to no pressure whatever. When the powder is spoken to, the words are truly rendered in the telephone, all grating sounds being absent.

FREDK. JOHN SMITH.

Taunton, *January* 29, 1879.

Notes.

THE ELECTRIC LIGHT.—The Wallace-Farmer electric light has been selected to light the pier-head at Avonmouth Dock.

THE Society of Telegraph Engineers have arranged for a great field night with the electric light at the Albert Hall soon. The band will probably play "The Light of other days is faded."

MR. LATIMER CLARK will lecture on the "Electric Light" at the Eyre Arms on March 6.

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ELECTRIC INCANDESCENCE.—In an interesting paper in the *Monthly Journal of Science*, Prof. Ayrton arrives at the conclusion that a wire of platinum 1 millimetre in diameter (about No. 20 B.W.G.) and 5 centimetres long can be rendered incandescent by maintaining a difference of potential of 0·285 volts, or about $\frac{1}{3}$ that of a Daniell cell. Similarly, a carbon wire of same diameter, but only 2 centimetres thick (to make it the same resistance as the platinum), requires an electromotive force of 0·460 volts, or about $\frac{1}{2}$ that of a Daniell cell.

DE MOLEYN'S ELECTRIC INCANDESCENCE PATENT.—The first English patent for electric incandescence is, as pointed out by Professor Ayrton, not King's 1845 patent, as is generally supposed, but one dated August 21, 1841, and in the name of Frederick de Moleyns, of Cheltenham, Gloucestershire, for the "Production or development of electricity and its application to illuminating and motive purposes." This ingenious patent describes, among other things, an electric lamp formed of a glass globe enclosing a spiral of platinum wire rendered white hot by an electric current passed through it. An increase of light is also provided for by allowing a stream of carbon dust to fall through the illuminated spiral from a reservoir above.

LUMINOSITY OF INCANDESCENT PLATINUM.—M. J. Violle has measured the intensity of red light emitted by platinum, at different temperatures from 900 to 1·775° C., the melting point of the metal. Taking the intensity of the red light emitted by platinum at 954° (the fusing point of silver) as unity, he finds that the intensity I of the same light at temperature t is represented by the formula

$$\text{Log. } I = 8{\cdot}244929 + 0{\cdot}011475\, t - 0{\cdot}000002969\, t^2$$

which gives

at 800°	I = 0·108	At 1400°	I = 100
900	0·475	1500	194
1000	1·82	1600	327
1100	6·10	1700	481
1200	17·8	1775	587
1300	45·2		

By passing the whole of the rays from fusing platinum through thin plates of rock salt and alumn, and measuring their intensity by a thermo-pile, M. Violle finds that the luminous heat transmitted across the alumn is only $\frac{1}{4{\cdot}5}$ of the total heat transmitted by the rock salt. Hence it follows that at 1·775° C. the more refrangible rays appear in greater proportion than at temperatures some hundreds of degrees lower.

WE hear that the city of San Francisco is to be lit by electricity, supplied by the Gramme machine. For this purpose it will be divided into districts, each having a radius of three miles.

THE ELECTRIC LIGHT FOR RAILWAYS.—Our contemporary *Engineering* recently illustrated a travelling electric light generator constructed by the Messrs. Ransomes, Sims, and Head, engineers, Ipswich, which supplies a want felt by railway engineers and contractors for a portable light of great power to be used in illuminating works on the permanent way by night or in tunnels. It consists of a light engine mounted on four flanged wheels, capable of moving itself forward or backward at the rate of 1 to 2¼ miles per hour, with a dynamo-electric machine fitted to the front part of the boiler and driven by a strap from the fly-wheel. The light, which may be of any system, is fixed in front of the smoke-box. When the engine travels along the line the dynamo-machine works at its proper speed, and when it is necessary to stop, in order that the light may be directed on some particular spot, the driving wheels are thrown out of gear, and the engine ceases to be a locomotive, whilst the engine continues to drive the machine at its proper speed. Sensitive governors to regulate the current are provided. When not required for lighting purposes the engine may be used to pump water, saw wood, or drill.

WE hear from a private source that Mr. Edison will visit this country in May.

THE TELEPHONE.—It is rumoured that Bell and Gray are likely to come to terms over their telephonic dispute, a consummation devoutly to be wished.

BELL'S TELEPHONE has been fitted up in the rooms of the Royal Geographical Society.

THE MICROPHONE has enabled Mr. Crossley, of the well-known firm of Crossley Bros., Engineers, to hear a fly walking twenty miles distant.

AËRIAL TELEGRAPHY.—Prof. Loomis continues his experiments in telegraphing through the upper air by means of natural currents of electricity, and without the use of wires. He has built towers on peaks of the West Virginia mountains 20 miles apart, and erected metal rods from these as electrodes to pierce the electric strata of the air, and with telephones in this aërial circuit he can converse a distance of 20 miles (?)

THE TELEGRAPH IN CHINA.—We hear that, through the enterprise and wise policy of the Viceroy, His Excellency Li Hung Chang, telegraph stores have been purchased, and that under the direction of Mr. J. A. Betts (the director of the Imperial Torpedo College, Tientsin) the *first* telegraph line for the transmission of *public messages* will be erected, and will probably be in working order within three or four months from this date. This will be a line of some 40 miles in length, and will no doubt be very rapidly extended. Thus we may expect to find that within the next decade the use of electricity in China will be as much a fact as in Europe or America.

SIR J. ANDERSON will lecture on the "Telegraph" at the Working Men's Club, Great Ormond Street, on March 5.

INVIOLABILITY OF TELEGRAMS.—Whether or not telegrams should be regarded as sealed communications, like letters, is a question much discussed just now in the United States, and it is expected to receive the early attention of Congress. It appears that while telegrams are in every American State protected by penal statutes against voluntary disclosure, and are subject to disclosure under judicial authority like other evidence, they are without any protection against a search warrant in the form of the subpœna *duces tecum* except such as may be found in the consciences of those who exercise irresponsible power.

THE GALVANOPHONE, or Electric Songster, an amusing toy, manufactured by the General Novelty Company, is a species of musical telephone, actuated by a bichromate battery, seems capable of affording a good deal of fun, as it is in the habit, like some of Lord Beaconsfield's heroines, of occasionally bursting into melody.

As the West India and Panama Company's repairing ship, *Investigator*, was leaving St. Thomas, on Jan. 8, her boiler exploded.

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TELEGRAMS can now be sent all over Guatemala for a shilling. The lines are Government property, and are superintended by Mr. Stanley McNider.

CURIOUS THERMO-MOTOR.—Profs. Elihu Thomson and Edwin J. Houston, two American men of science, who labour in a truly scientific spirit, and not, as is too common in their country, for mere gain, have recently devised a motor which possesses a theoretical interest. A small wheel or disc of steel is placed between the poles of a horse-shoe magnet, where it is free to rotate round an axle, the edges of the wheel being opposite the poles. In this position the wheel of course becomes magnetised by induction. If now any section of the wheel be heated the disc will move, because the heat lessens the coercive force of the heated part, and hence the magnetic equilibrium is disturbed, producing motion of the wheel.

EXTENSION OF DR. KERR'S EXPERIMENT.—It is well known that a block of glass, through which a powerful discharge of electricity is passed, that is, a block subjected to intense electro-static stress, has power to shift the plane of polarisation of light. This is usually shewn by projecting the beam of polarised light which traverses the glass on a screen where it makes a white spot. While recently performing this experiment, Mr. J. E. Gordon, B.A., accidentally allowed the electro-static stress to become strong enough to perforate the glass. Immediately before perforation there appeared first a patch of orange-brown light about 6 or 7 inches diameter upon the screen. This at once resolved itself into a series of four or five irregular concentric rings dark and orange brown, the outer one being perhaps 14 inches diameter. In about two seconds more these vanished and were succeeded by a huge black cross about 3 feet across, seen on a faintly luminous ground. The arms of the cross were along the planes of polarisation, and therefore (the experiment being arranged according to Dr. Kerr's directions) were at 45° to the line of stress. The glass then gave way, and all the phenomena disappeared except the extreme ends of the cross, and the discharge through the hole, where the glass had been perforated, was alone seen.

IN a letter to the Philadelphia *Times*, Mr. David Brooks, the well known inventor of Brook's insulator, lays claim to having first discovered that a two-twisted wire circuit overcame the induction clamour on telephone lines, a plan which has been patented by Prof. Bell.

HEAT OF MAGNETISATION.—Prof. Hill, of the United States Torpedo Station, Newport, R.I., finds that the molecular heat developed in equal volumes of iron, cobalt, and nickel, by rapid magnetisation, expressed in work done, was for iron 2381·43, for cobalt 1906·50, for nickel 1112·11 metre-grammes.

New Patents—1879.

485. "Improvements in and appertaining to sounders for telegraphic purposes. J. R. EDWARDS. Dated Feb. 7.

508 "Improvements in shades or lanterns for electric or other lights." H. VANDER WEYDE. Dated Feb. 8.

513. "Improvements in electro-dynamic apparatus." JOHN IMRAY (communicated by Francois J. Endrés, Paris). Dated Feb. 10.

523. "Improved apparatus for obtaining electric currents, and means for obtaining light from electric currents." E. T. BOUSFIELD and W. R. BOUSFIELD. Dated Feb. 10.

529. "An improved process of electro-plating by an amalgamation or combination of silver and alloys of tin and other metals, to be called 'silverette.'" T. H. BLAKE. Dated Feb. 11.

565. "Improvements in the construction of dynamo-electric machines employed for generating electric currents." JOHN FORMBY. Dated Feb. 13.

595. "An improved method of generating compound induced currents for telephonic and other purposes. R. H. COURTENAY. Dated Feb. 14.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

1988. "Phonic wheels." PAUL LA COUR. Dated May 17. 6d. This describes various phonic wheels, or toothed discs rotated by the electro-magnetism generated by harmonic currents. (See TELEGRAPHIC JOURNAL, Dec. 1, 1878.) The wheel can be used as a motor or an automatic speed regulator, for chronographs, &c.

2003 "Apparatus for the generation and application of electricity, for lighting, plating, &c." H. J. HADDAN. Dated May 18. 1s. This describes Brush's electric lighting apparatus. (See TELEGRAPHIC JOURNAL, Jan. 15, 1879.)

2024. "Continuous rolling-mills." B. J. BARNARD MILLS. (Communicated by W. R. Jenkins, jun., Bellefonte, United States. Dated May 21. This relates to the construction of the rollers of telegraph and other wire mills without twisting guides.

2096. "Hydro-electric brake for railway trains, &c. W. MORGAN-BROWN. (Communicated by Jules Sabatier, and Louis Pouget, Montpellier, France.) Dated May 25. 6d. Electricity is employed to apply the brake, the motion of the train is made by means of hydraulic pressure to arrest the latter.

2137. "Telegraph signalling apparatus for increasing the speed of working telegraph cables, &c." FREDERICK TRIMMER. Dated May 29. 2d. One or more electro-magnets with armatures actuated either by a local battery or the working battery, are combined with the peg in such a way that they curb the signal currents. *Not proceeded with.*

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the meeting of this society, held on February 13th, Major Bateman-Champain (President) in the Chair, Mr. Willoughby Smith read a paper on the "Working of Long Submarine Cables."

In commencing his paper, Mr. Smith put together a brief history of the working of long submarine cables from twelve years ago up to the present time. When electro-magnets were introduced into the instruments used for working long lines, retardation of signals was produced, to overcome which Jacobi employed "polarisation" batteries. In 1860, Mr. C. F. Varley effected the same object by means of "condensers," and in December, 1862, the same gentleman adopted condensers and resistance coils combined, so as to

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produce quick signalling on submarine cables, also employing an iron core in the resistance coil to produce a more effective result. Several combinations of these elements were suggested by Mr. Varley, but none, as far as Mr. Smith was aware, were practically tried.

In 1865, the "curb key" was devised by Sir Wm. Thomson and Mr. Varley for working the Atlantic Cable laid in that year. In this instrument, by a mechanical arrangement, three or more currents of equal strength, but of unequal duration, could, in quick succession, be alternately sent through the cable. On working this key through the cable coiled on board the *Great Eastern*, a speed of about six words a minute was attained.

In 1866, Mr. Smith introduced his well-known method of continuous testing, by which messages could be transmitted between the ship and shore without interrupting the insulation test. This system was improved by Mr. Laws and Mr. Varley. On practically working this system, it became apparent that a speed of signalling could be obtained with it greatly in excess of that which could be obtained with the curb key; in fact, as high a rate as thirteen words per minute was attained with ease, and subsequently this was increased to twenty-five words as the clerks became skilled in the working.

In drawing a comparison between the mirror and the siphon recorder systems of working, Mr. Smith stated that a *good* mirror clerk prefers the mirror instrument, while an *inferior* reader prefers the recorder.

In considering the question of the use of electro-magnetic shunts for working long submarine circuits, Mr. Smith stated that all his experiments tended to show that their employment was prejudicial to a high working speed.

At the conclusion of his paper, Mr. Smith gave some details of experiments on duplex working through cables, showing what balancing, resistances, and capacities gave the best results, the signals being received on a siphon recorder.

A paper by Mr. J. GRAVES, of Valentia, on "Curbed Signals," was then read by the Secretary.

In the discussion which followed the reading of the papers, Mr. C. F. Varley pointed out the advantage to be gained by the use of a resistance coil combined with the condenser at the receiving end of the cable, the resistance enabling the cable to discharge itself more readily.

The meeting then adjourned.

PHYSICAL SOCIETY.

AT the meeting on Feb. 22, Prof. W. G. ADAMS (President) in the Chair,

Dr. C. W. SIEMENS gave an account of his current regulator, illustrated by us in this number. Dr. Coffin stated that he had thought of a regulator in which the heating of a spiral wire in a gaseous chamber would cause the gas to expand and drive up a column of mercury past a series of contacts, which would throw resistances in circuit. Dr. Guthrie suspected from some experiments of his that the conductivity of metals was not strictly proportional to their sectional area.

Dr. SCHUSTER then read a paper on "The Spectrum of Lightning." He stated that while in Colorado last year on the Eclipse expedition, he had made three observations of the spectrum of lightning: one at Las Animas, on horizon lightning, one in the Rocky Mountains, at Manitou Springs, on the flashes from a cloud overhanging Pikes Peak, and one in front of the hotel at Salt Lake City. The spectrum showed three nitrogen lines and four bands, one of the bands, however, being doubtful. One of these bands is that obtained from oxygen at low temperatures, but Dr. Schuster has tried in vain to get it from air. On the whole, Dr. Schuster is of opinion that the bands agree, but with the spectrum of the light seen at the negative pole of a discharger in oxygen mixed with a trace of carbonic oxide.

City Notes.

Old Broad Street, Feb. 26, 1879.

THE fifteenth ordinary general meeting of the Cuba Submarine Telegraph Company (Limited) took place on Wednesday, the 19th inst., at the offices, Old Broad-street, under the presidency of Mr. Thomas Hughes, Q.C., the Chairman of the Company. The report, an abstract of which appeared in our last issue, having been read, the Chairman, in moving the adoption thereof, first alluded with very deep regret to the sudden death on the previous Sunday of the chief officer of the Company, Mr. Brand, who had been their secretary and manager from the establishment of the Company ten years ago. He was sure that the shareholders would regret his decease as deeply as the directors did. They would do their best to supply his place as worthily as possible. As to the question of dividend, they had recommended one at the rate of only 6 per cent. per annum on the ordinary shares, and he thought that, considering the state of their property in the West Indies, they would all be of opinion that that dividend was quite as much as they could prudently declare on the present occasion. That time last year several shareholders expressed the opinion that the Company could have quite fairly declared a larger dividend, and they founded their views as to the amount of the dividend which should be declared upon the fact of the vastly improved condition of the cable. Mr. Hooper, too, whose knowledge made him an authority on such a subject, argued as a reason for the dividend being increased that the "life" of the cables would prove to be considerably longer than the estimate adopted by the Board. He, however, thought the experience of the past year had shown that the policy of limiting the dividend was a wise one, because it seemed to show that the "life" of the cables, so far from being longer than the Board estimated—10 years—was likely to prove shorter; and they had also had the misfortune to have again to undertake the repair of faults in their cable. That morning they received a telegram from their manager at Jamaica—who was now engaged in the repair of the cable—to the following effect:—"Picked up cable; lost the Santiago end, and buoyed the Cienfuegos"; so they might expect almost immediately to hear that the first portion of his work had been satisfactorily performed. Until, however, the whole of the work had been completed they could not ascertain what the expense would be with any certainty, and therefore they recommended the dividend mentioned, and that the whole of the balance of £4,053 should be carried forward, so that they might be enabled to pay the expenses out of it. The decree of the Court of Madrid, as to the tax imposed by the Spanish Government upon the local business of the Company, had been received, and the result was that the claim of the Company had been, to a great extent, allowed, and about £1,200 would have to be returned to them by the Spanish Government. The motion having been seconded, the Chairman, in reply to questions and observations, said that negotiations were going on as to the Para cable, and they trusted that the connection might be made with South America, which would be of immense advantage to this Company. The opinion of

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the Board as to the "life" of a cable, was of no more value than that of other persons connected with telegraphic business, but they had only to look to facts as connected with their own business; and although he admitted that their experience might be exceptional, he did not think they would be justified in treating their cable as likely to have an undisturbed "life" of more than ten years. Experience showed that the West Indian seas were not favourable to the "life" of a cable. As to the remarks about the defective nature of the last cable laid for them—the india-rubber cable—it had been constantly under the consideration of the Board whether there was any fault attributable to the manufacturer; but it was impossible for them to ascertain whether the fault lay with, and could be brought home to, the manufacturer or not till the fault was reached. The cable, however, was constantly inspected and severely tested during its manufacture by Mr. Keith, who was now repairing it. The motion was then unanimously adopted, and the dividends having been declared, a vote of thanks to the Chairman and directors terminated the proceedings.

According to the report of the Telegraph Construction and Maintenance Company (Limited) the accounts for the year show a net profit of £87,746, after charging the interest on the Debentures. To this sum must be added £61,247 brought forward from last year, making a total of £148,993. From this amount is deducted the interim dividend of 5 per cent., paid 10th July, 1878, amounting to £22,410, leaving £126,583 to be dealt with. Of this sum the directors propose to distribute a dividend of 15 per cent., or £67,230, being at the rate of £1 16s., per share, and making with the amount already paid, a total dividend for the year of £2 8s. per share in cash, free of income tax, leaving £59,353 to be carried forward to the next account.

The Western and Brazilian Telegraph Company (Limited) notified on the 15th inst. that telegraphic communication has been completed from Para to Monte Video. This places the Company's entire system, including the new line into Maranham, for the *first time* in complete working order. The cables are now working from Para to Monte Video, including all the intermediate ports required by the Company's concession. During the last twelve months, out of the original Western and Brazilian line from Rio de Janeiro to Para, viz., 2,517 miles, 830 miles of new cable, nearly all sheathed, has been relaid in shallow waters, leaving but a moderate length in these waters which it will be necessary hereafter to renew. The engineers report that the original cable, laid in deep water, is in excellent condition.

The Anglo-American Telegraph Company's Brest cable was broken on the morning of the 23rd inst. during a violent temptest, which had been raging for 36 hours. The cable was broken about 161 miles from St. Pierre, in 500 fathoms of water. The Company's ship has been ordered to sea at once to effect the repair.

The Direct U.S. cable is not yet repaired, there are therefore at present but two Atlantic cables at work; both are, however, duplexed.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 59-59½; Ditto, Preferred, 86-87; Ditto, Deferred, 31-31⅛; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 8¼-8¾; Cuba, Limited, 10 per cent. Preference, 15½-16; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10-10½; Direct United States Cable, Limited, 1877, 11⅛-11¾; Eastern, Limited, 7¼-7⅛; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1887, 100-103; Eastern, 6 per cent. Preference, 11⅛-11¾; Eastern Extension, Australasian and China Limited, 7¼-7⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 10⅜-10⅝; Great Northern, 8⅛-8⅜; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 9½-10½; Submarine, 215-225; Submarine Scrip, 1⅞-2⅛; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 8½-9; Ditto, ditto, Second Preference, 7⅞-8¼; Western and Brazilian, Limited, 4⅛-4⅜; Ditto, 6 per cent. Debentures "A," 88-93, Ditto, ditto, ditto, "B," 83-88; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 31¾-32¼; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2⅛-2⅜; India Rubber Co., 10¾-11¼.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,102,420.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£ *b*	£	£	£ *b*	£
January, 1879 ...	50,400	13,778	*2,900	951	16,800	39,226	24,695	13,856	... ...	9,064	2,125	... ...	5,497
January, 1878 ...	49,940	11,883	3,001	944	13,730	41,531	22,905	13,511	... ...	9,621	1,725	... ...	5,284
Total Inc., 1879	*460	1,895	... ...	7	3,070	... ...	1,790	345	... ...	... ...	400	... ...	213
Total Dec., 1879	... ...	... ...	101	... ...	... ...	2,305	... ...	... ...	... ...	557	... ...	... ...	... ...

* Estimated. *b* Not published. Traffic Receipts of West Coast of America Co. for the month of December were £2,250.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 147.

THE CLERAC TUBE CONTROVERSY.

THE interesting controversy which has been going on in our pages of late may now be regarded as practically closed. It was opened by a letter from Professor Hughes, calling attention to a statement made by Professor Barrett at a lecture given by him on Edison's inventions at the London Institution, and reported in the *Times* of January 2nd, to the effect that "no trace" of Clerac's Tube could be found. Professor Hughes stated that he had used Clerac's tube, a powdered carbon rheostat, variable by pressure, since 1866, and invited Professor Barrett to see one still in his possession. Count du Moncel also drew attention to a paper of Professor Barrett's in *Good Words* for October, 1878, in which M. Clerac gets full credit for his tube. Professor Barrett replied that he did not doubt that Professor Hughes possessed one of Clerac's variable carbon rheostats, but that that fact did not amount to publication "in a scientific sense"; that he had searched in vain for a published account of Clerac's Tube, and had only been able to find mention of it in the *Journal Télégraphique* for March 25, 1874, in connection with a prior controversy, in which Professor Zetzsche held that rheostats of powdered carbon had been used in Germany in 1865, before Clerac's was introduced there by Professor Hughes in 1866. Clerac's tube was here simply described as a rheostat of powdered carbon compressed, no mention of variability being made. Professor Barrett also gave a quotation from a private letter of Mr. Edison, in which Mr. Edison states that he tried tubes similar to M. Clerac's with carbon in every degree of subdivision, but could get no apparatus to detect the change of resistance produced by pressure, and, hence, doubted the existence of the rheostat in question. The fact, however, that Mr. Edison could not make these tubes does not prove their non-existence, although he seems to think so; and, moreover, it is curious to compare the authorised description of his "Pressure Relay" published in the *Journal of the Telegraph* for June 1, 1877. "He (Mr. Edison)," says this account, "takes advantage of the property which plumbago possesses of decreasing its resistance enormously under slight pressure." Now this plumbago is a material used in Clerac's Tube, and it is a singular fact that it should possess one set of properties when used in Edison's Pressure Relay and another when employed in Clerac's Tube. There appears to be an uncertainty in the manufacture of powdered carbon resistances which lowers their practical value. Dr. C. W. Siemens recently stated, for instance, that he had quite failed to make carbon resistances which gave the wide variations of resistance obtained by Mr. Edison. He attributed the fact, however, to his own want of skill, and it does not seem to have occurred to him to deny the existence of Edison's carbons because he himself had not been able to construct them. In the same letter Professor Barrett called for Professor Hughes' evidence as to Clerac's Tube.

Professor Hughes replied by producing the results of an enquiry instituted by M. Cochery, the French Minister of Posts and Telegraphs, which comprised among others, a letter from Professor Hughes to M. Clerac, bearing the Paris postmark for March 10, 1866, in which the tube is alluded to, and a letter from M. Hardy, the eminent French electric-mechanician, in which he attests to resistances of carbon meant to be varied by pressure, were constructed for M. Clerac at the end of 1865 or beginning of 1866. M. Clerac also explained that the reason why the tube was not more fully described in the *Journal Télégraphique* for March 25, 1874, was that such a description was not necessary for the purposes of the controversy, and remarked that it is only necessary to see and use the tube to know that it is designed as a variable resistance. A letter from Mr. Despointes, superintendent of the Submarine Telegraph Company, also certified that Professor Hughes had used it in 1871 on the lines of that company. Count du Moncel also drew attention to the fact that long before either M. Clerac or Mr. Edison had discovered the variability of powdered carbon resistances under pressure, he himself had found it out, and published it in the *Comptes Rendus* for December 2, 1872.

Lastly, Professor Barrett, while admitting the conclusiveness of Professor Hughes' evidence as to the existence of Clerac's tubes since 1866, throws doubts upon such evidence as amounting to *publication*, and infers, that although "a resistance tube having some resemblance to Edison's carbon rheostat was doubtless made by M. Clerac, the use now claimed for it was generally unknown." Professor Barrett also admits Count du Moncel's claim to the discovery in dispute.

From the above summary it will be seen that the controversy shifted its ground. It was originally raised by Professor Barrett's statement that "no trace of Clerac's tube could be found"; but Professor Barrett explained that he did not doubt the

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existence of the tube, and it became a question of publicity. As regards the first point it is, perhaps, to be regretted that Professor Barrett did not make a more qualified statement than that "no trace of Clerac's tube could be found," since an audience hearing these words would be liable to conclude that the story of the existence of these tubes was a myth. That this could not be the intention of Professor Barrett appears from his avowal of belief in the tubes possessed by Professor Hughes. Had he said in his lecture that "no trace of the publication of Clerac's tube could be found," it seems to us that he would have done more justice both to himself and to M. Clerac. Be this as it may, however, the major point at issue is the question of publicity. M. Clerac does not appear to have published a scientific description of his tube in any journal. He is an official of a government administration, which discountenances public prominence on the part of its members; and among other reasons he may not have considered the tube of sufficient moment to merit publication of the kind. Indeed it has acquired its recent importance from the microphone dispute. It is clear, however, that these tubes were used in a number of European countries by Professor Hughes, and shewn to the telegraph *employés* there during 1866 and subsequent years. Does this circumstance, taken in conjunction with the fact that public reference was made to them in the *Journal Telegraphique* constitute publication? Legally it would, perhaps, be a nice question to decide, and even if it should be ruled that professional usage to the extent implied in this case, does not amount to publicity, still facts are facts, and it cannot be forgot that Clerac *did* invent these tubes, and that they were made use of by Professor Hughes and others on and after 1866. The branch discussion whether or not Clerac first invented these tubes is beside the present controversy; but it is obvious that if Professor Zetzsche's claimant made carbon pressure rheostats before Clerac, Mr. Edison's title to the invention is still further removed.

The results which may be extracted from the controversy we have been considering are briefly these: that it is to Count du Moncel that the discovery of the variability of the resistance of powdered carbon by pressure in 1856 must be attributed; that a powdered carbon rheostat, made to vary in resistance by application of pressure was invented by M. Clerac in 1865; and that Mr. Edison applied the same property of carbon to the construction of a speaking telephone transmitter; the voice giving the air pressures required. Mr. Edison, probably, re-discovered this property of carbon—no one has implied that he did not—a forbearance which will not pass unmarked when it is contrasted with the harsh imputations which have emanated from America on this subject. It has now been clearly proven, however, that he was anticipated in the discovery; and he will, we feel sure, be propitiating his best fame, if he resigns his claim to priority here and contents himself with his undoubted rights to the remarkable invention of the carbon telephone transmitter.

Of the bearing of this controversy on the invention of the microphone we do not intend to enter. It is either ignorance or wrongheadedness which does not recognise any difference between the carbon-telephone which *does* depend on the variable resistance of *powdered carbon* under pressure, and the microphone which depends on the sensibility of delicate *joints in a conducting circuit*, to the influence of sonorous sounds, and other vibrations. This matter was settled long ago by Sir William Thomson, and there would be nothing gained by dwelling on it now. We may, therefore, conclude by drawing the inevitable but still unheeded moral, that all novel inventions and discoveries should be published to the world.

RISCH'S DOUBLE CURRENT KEY.

THIS form of key is especially adapted for working long lines, as by its use the signals are rendered decided and free from tailing.

The knob is divided into two parts, one on the main lever L^1, and the other on a side lever L mounted on L^1 by an insulating pivot 6, and acted on by a spring 7 so as to keep the two parts of the knob asunder, except when they are closed together by the hand of the operator when he is about to use the key. Until so closed the lever L connected to line by the spring 7 completes circuit from the line to the relay for receiving signals. On closing the knob this circuit is broken, and the line is then put in circuit with the key lever L^1, which by the screw 1 is in circuit with the zinc pole of the battery. On the back part of the key lever L^1 are mounted by pivots f and f^1, two side levers A and B, of which A is in metallic contact with L^1, and B is insulated from it; A is drawn by a spring 8 on to the screw 3, which is connected to the zinc pole o the battery, and B is drawn by a spring 9 connected to earth on to the screw 2, connected to the copper pole. Thus when the knob is closed the line is connected to the zinc, and earth to the copper pole. On the lever L^1 are fixed two insulated brackets C and Z, connected respectively to the copper and zinc poles, and having screws 4 and 5 so adjusted that they are just clear of the front ends of the levers B and A, when their back ends rest on 2 and 3.

When the operator having closed the knob depresses it, the following changes of connection take place:—Contact is first broken between 1 and Z, but the lever A maintains connection of line and zinc, and 4 coming in contact with B makes connection to

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earth. By farther depression of the key the contacts of A and B with 2 and 3 are broken, and then contact is made at C. In the ascent of the knob a similar series of changes of circuit are effected in reverse order, and thus in both cases the line is discharged in the course of the key's movement, and the discharge is followed up by an impulse of

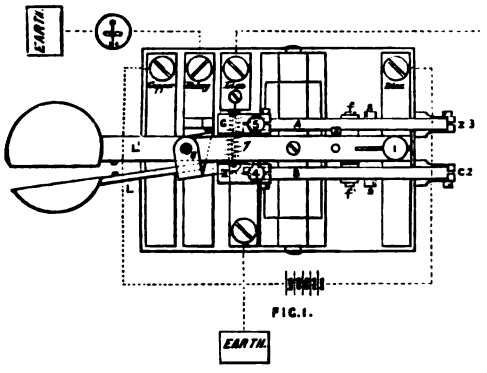

FIG. 1.

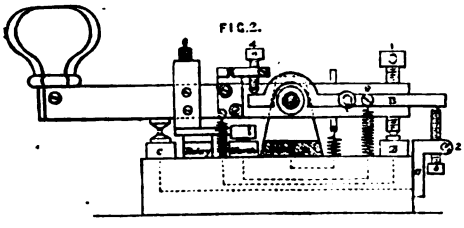

FIG. 2.

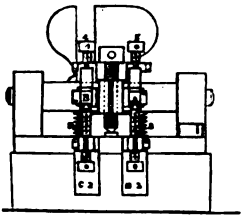

FIG. 3.

the opposite sign to the previous charge, and this gives the receiving instrument or relay a decided action.

The period of discharge may be varied in duration by adjustment of the screws 4 and 5.

AN ELECTRO-MAGNETIC TICKET COUNTER for railways has been adopted at a railway-station in Vienna to number the passengers of each class travelling by any particular train. This is a useful contrivance, and enables the station-master to apportion the proper number of carriages to the traffic.

INDUCTION ON AIR-TELEGRAPH LINES.

EVERY well-versed electrician knows that when two neighbouring telegraph wires are working, the signal currents in one induce feebler but corresponding currents in the other. The effect of these induced currents on a very sensitive receiving instrument, such as the speaking telephone, is to perturb its signal, causing a confused clamour of sounds which quite smothers up the small voice of that instrument. Now the tendency in telegraphy is, of course, to obtain greater speed of working on lines, and in order to do this more sensitive instruments are required. For the retarding effect also of earth induction on current signals, which causes them, as it were, to plough their way along against an influence tending to hold them back, and the wave-like form which the signals assume under this influence, render it necessary to make the receiving instruments more sensitive, so as to appreciate smaller fluctuations of current strength, if greater speed be aimed at. It is evident, however, that there must be a limit to this sensitising of the receiver if the induction of neighbouring currents is to be left uncorrected, for the receiver may be made so sensitive that, like the telephone, it will be perturbed in its action by these induction currents. There is no mechanical obstacle to making receiving instruments which will record 1000 words per minute, could these induced currents be prevented from influencing them. Until the researches which Professor Hughes brought before the Society of Telegraph Engineers last Wednesday (March 12), very little, if anything, had been done by electricians to neutralise the evil. It has hitherto been evaded by them in employing powerful currents to work insensitive instruments, and in having recourse to multiple methods of telegraphy. The time is come, however, in which this question will have to be seriously grappled with by telegraph administrations, and as the sensitive telephone has been the means of bringing back the wandering attention of electricians to the subject, so has it been, in the hands of Professor Hughes, the means of enabling him to give us the first contribution towards a solution of the difficulty.

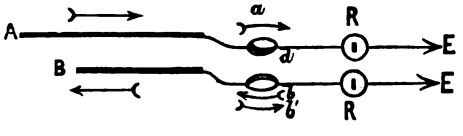

FIG 1.

One of the cures for current induction suggested by Professor Hughes can be explained by help of fig. 1, where A and B are two neighbouring telegraph lines, one being longer than the other for the sake of generalising the case. Between each line and its receiving instrument R, a coil of wire *a* for line A,

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and *b* for line B, is inserted. Now the length of the wire in coil *a* is proportioned to the length of the line A in the same ratio as the length of wire in the coil *b* is proportioned to the wire B, that is, supposing the kinds of wire for each to be similar. The coils themselves are of the same diameter, only *a* will have more turns than *b*, the line A being longer than B. The distance *d*, between these two coils, also bears a relation to the distance between the lines, a relation found by experiment; and if the line A is directly above B the coil *a* should be supported directly above *b* and parallel with it. On the other hand if A be not in a vertical line above B on the telegraph posts but displaced sideways, as on the French lines, then the coil *a* must be displaced laterally to a proportionate extent, while being above it. The coils *a* and *b* thus posed form a compensating arrangement to the mutual induction of the two lines. This induction compensator, as Professor Hughes calls it, can be easily made by causing the coils to slide up and down a vertical stem in the case of wires vertically over each other, and giving them also a lateral motion in the case of wires placed otherwise. It is in fact an artificial land line, just as Muirhead's inductive-resistances are an artificial cable.

We have yet to see how it operates in neutralising the induction. Let us suppose that a signal current is passing in the direction of the arrow, along the line A and the coil *a*, to earth through the receiver R. Now if the coil *a* be wound in the same direction to the coil *b*, this current will evoke an induction current in the reverse direction in the line B and the coil *b*, as shewn by the arrows. This induction current will make a false signal on R if it is, like the telephone, sufficiently sensitive. If, however, the position of the coil *a* be reversed with respect to *b* so that the current circulates round its turns in an opposite direction to what it did in the case we have been considering; the induction of the coil *a* on *b* will be such that an induction current will be set up in *b* in the *same* direction to the primary current through *a*, as shewn by the arrow *b'*. At the same time the induction current in B will remain, as before, in an opposite direction to the primary current in A. But the coils *a*, *b*, have been so proportioned and placed with respect to the lines A, B, that the induction effects in them are equal to those in the lines themselves. Hence the equal but contrary induction currents in B and its coil *b*, neutralise each other and no false signal can be made on the receiving instrument R in circuit with B. In this way the two lines are screened from each other's dynamic-induction. The adjustment of the compensating coils is best effected by means of a telephone in circuit, and Prof. Hughes employs a microphone placed near a ticking clock to give the sonorous currents. The adjustment is made by shifting the coils with respect to each other till no induction sound is heard on the telephone. The insertion of soft iron rods into the hollow of the coils also affects the balance very sensibly; and Professor Hughes finds that according as one or more of these rods are inserted the mutual induction of the coils is more and more lengthened out. By these rods the arrangement can be made to compensate for the length of the induced signal as well as for its intensity.

The plan of using a return wire for telephone circuits in order to overcome the induction clamour is a well-known one; that of enclosing the wire in a conducting envelope in connection with earth, though efficacious in the case of statical electricity, is worthless for dynamic electricity. It occurred to Professor Hughes that the going and returning wire should be twisted round each other; but as was pointed out in a note of our last issue, this plan has been already patented by Professor Bell, and claimed by Mr. David Brooks, the American electrician. The

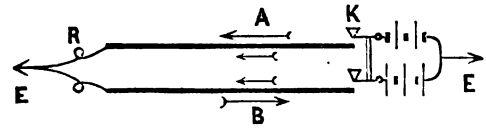

FIG. 2.

modification of this plan, shewn in fig. 2, is, however, due to Professor Hughes. Here A and B are the going and returning wires twisted round each other. The battery is earthed in the middle and the poles are connected to a double pointed signalling key K, so that when the key is worked by the sender, the signal consists of simultaneously applying the positive and negative poles to the two wires A and B. The receiving instrument R is wound differentially, and the signal currents flowing along A and B in the direction of the outer arrows, work the receiver conjointly. On the other hand the equal induction currents produced by primary currents in a neighbouring circuit, being in the same direction in both wires, as shewn by the inner arrows, pass in opposite directions through the receiver and neutralise each other.

A NEW THEORY OF THE EARTH'S MAGNETISM.

AT the latest meeting of the Physical Society, on March 8, Professor Ayrton brought forward a new theory of Terrestrial Magnetism, originated by himself and Professor Perry of the Imperial Engineering College, Japan. It is well-known that metal cages act as screens against induction in the case of static electricity, or electricity at rest, and hence Clerk-Maxwell, at the B. A. meeting for 1876, suggested that no earth connection was necessary for lightning conductors since a cage would be sufficient. But dynamic electricity is different from static in this respect, and Professors Ayrton and Perry found that even a thick block of copper will not screen a coil of wire from the induction of a *current* flowing in a neighbouring one. Some

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experiments of Dr. Muirhead, not yet published, would seem to favour the view that a current is a series of intermittent changes of potential, and that the inductive effect is due to a difference in the epochs of the currents in the two coils. It was found by Helmholtz that a quantity of static electricity in mechanical motion performs work. Conversely, Mr. Crooks finds that the stream of molecules from a — pole in vacuo is electrified and may be deflected by a magnet. It is upon this fact that Professors Ayrton and Perry have based their theory, which is easily explained by supposing the earth to be an isolated sphere with a static charge residing on its surface. Then since each electrified particle at the surface will be moving relatively to a point in the interior, it follows that the interior must be magnetic. The theory is independent of the substance of the interior; but in order to simplify the working, the authors treated the case of a solid iron ball, and curiously enough arrived at the result expressed by Biot's law for the distribution of magnetism on the surface of the earth.

$$I^2 = M\sqrt{1 + 3\cos^2\theta},$$

and similarly they found that if the earth were electrified to the potential of 10^8 volts relatively to interplanetary space, its magnetisation would be as it is. If the earth were alone in the universe then, by this theory it would have its own magnetic state by virtue of its electric charge and axial rotation. If other bodies in the universe, however, had their magnetic states too, these would influence the earth's, and hence we should have terrestrial tides and storms of magnetic force, such as are known to exist, as for instance when changes take place in the sun's atmosphere by approach of planets or other causes. Lastly, the iron in the interior of the earth may give it a certain amount of coercitive force, but the theory does not rest on this.

ON THE SPECIFIC INDUCTIVE CAPACITIES OF CERTAIN DIELECTRICS.

By J. E. H. GORDON, B.A. Camb.*

As it would be impossible within the limits of an abstract to give any intelligible account of the new method of experiment (due to Professor Maxwell) which has been employed, I will merely give the table of results, reserving all discussion and explanation until the publication of my paper in full.

I may, however, state that the method is a zero method, that the electrified metal plates never touch the dielectrics, and that the electrification, which is produced by an induction coil, has an electromotive force equal to that of about 2,050 chloride of silver cells, and is reversed some 12,000 times per second.

RESULTS.

Dielectric. Glass, Slabs about 1 in. thick.		K.
Chance's optical glass.	Double extra dense flint	3·1639
	Extra dense flint	3·0536
	Light flint	3·0129
	Hard crown	3·1079

* Proc. of the Royal Society.

Dielectric. Glass, Slabs about 1 in. thick.			K.
Common plate, 2 slabs.	No. 1	3·2581	3·2431
	No. 2	3·2282	
Ebonite, 4 slabs, ¾, ½, ½, ¼ inch.	No. 1	2·2697	2·2838
	No. 2	2·2482	
	No. 3	2·3097	
	No. 4	2·3077	
Best quality gutta-percha			2·4625
Chatterton's compound			2·5474
India-rubber	black		2·2200
	vulcanized		2·4969
Solid paraffin, sp. gr. at 11° C. ·9109. Melting point 68° C. 6 slabs cut in planing machine. Results corrected for cavities.	No. 1	1·9940	Mean ... 1·9936*
	No. 2	1·9784	
	No. 3	1·9969	
	No. 4	2·0126	
	No. 5	1·9654	
	No. 6	2·0143	
Shellac			2·7464
Sulphur			2·5793
Bisulphide of carbon			1·8096†

The following table compares the refractive indices of the transparent dielectrics with the square roots of the specific inductive capacities. In cases where there is a wide difference μ is taken from books on physics; wherever there was a close agreement it was carefully determined by the author, except in the case of paraffin, where the value is that given in Maxwell's "Electricity."

Dielectric.	$\sqrt{K}$.	Nearest value of μ.	Ray for which μ is nearest.
Double extra dense flint glass	1·7783	1·7460	Band in extreme violet in magnesium spark spectrum.
Extra dense flint	1·7474	1·6757	
Light flint ...	1·7343	1·5113	
Hard crown	1·7629	1·5920	
Plate glass ...	1·8009	1·543	
Paraffin	1·4119	1·422	Rays of infinite wave length.
Sulphur	1·6060	2·115	
Bisulphide of carbon	1·3456	1·6114	

[These results are, we understand, a correction of those given before by Mr. Gordon. See TELEGRAPHIC JOURNAL for July 15, 1878.—ED. T. J.]

* Messrs. Gibson and Barclay, "Phil. Trans," 1871, using a method entirely different from mine, obtained K=1·977 for paraffin. Correcting for a slight difference of density, I find that if they had used my paraffin their result would have been 1·9833.

† I am not quite certain of the accuracy of this result.

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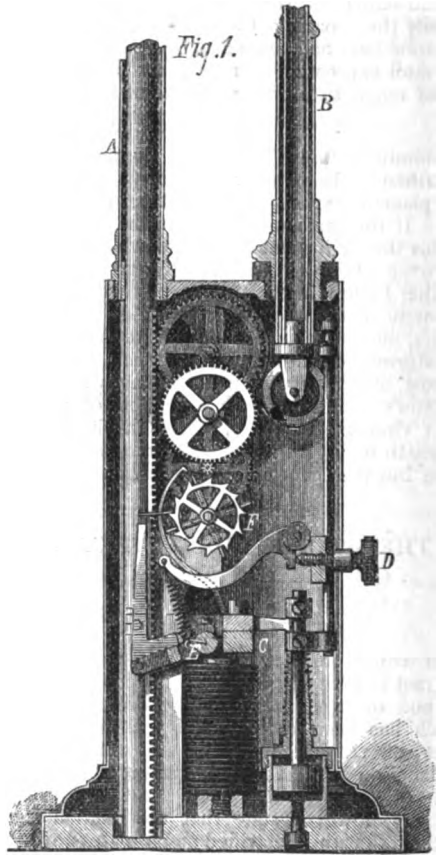
MAXIM'S ELECTRIC LIGHT.

WITHIN a short time past a new dynamo-machine, invented by Mr. Hiram Maxim, of New York, has been brought out, and is now being introduced by the United States Electric Lighting Company. This machine requires 1½ horse-power to drive it. It weighs 300 lbs., and produces a light of from 1,200 to 2,000 sperm candles, according to speed. The magnets are similar in form to those used by Dr. Siemens, of London, but the armature, or revolving portion, is of a new design, which is said to be free from many objections common to other machines. The only points where any considerable wear takes place on these machines are in the commutator, in which a stationary copper brush takes the current from the revolving part.

In some machines this portion has been built into the machine, so that when it is worn the whole machine would require rebuilding in case of repair. Mr. Maxim has constructed his machine so that the removal of a nut loosens the parts subject to wear, so that they may be replaced in a few minutes, and at a trifling cost.

Mr. Maxim has also produced a new lamp, which is shown in the accompanying figures. Fig. 1 represents a vertical section; fig. 2 a perspective of the same, together with some details. A is the positive carbon holder, and B the negative. The operation of the lamp is as follows: The negative carbon which may be 6 inches long, being secured in the lower holder B, the top holder may be drawn up, as the pinion that gears into its rack is free to turn in that direction without driving the train of gears. A carbon 11 inches long may now be inserted in the top holder, and its point brought in line with the lower carbon by moving the lever on the back side of the carrier.

The wires being connected to the binding post (one on each side of the lamp), the thumb nut G, being turned will allow the weight of the positive carrier to rotate the train of gearing, and by winding up a cord to draw the negative upward until the combined movement of both causes the points of the two carbons to meet. This will establish an electrical contact, and the current will at once commence to pass, the electro-magnet in the bottom of the lamp will become excited and draw downward the two armatures, one of which draws down one end of the cord that supports the negative carbon, and the other locks the gearing. The separation of the carbons by this downward movement of the negative establishes the voltaic arc, when the light comes out in all its splendour. As the carbons waste away the arc becomes longer, and the resistance to the passing current becomes greater, its power to excite the electro-magnet correspondingly decreasing. The armature E is drawn away from the magnet by a retractile spring, the tension of which is adjusted by thumb screw D. When the magnetism is so much reduced that the pull of the spring is greater than the pull of the magnet, the spring will force the armatures upward and remove the detent from the ratchet wheel F, thus allowing the train of gears to move so that the carbons slowly approach each other until a point is reached where the arc is shortened sufficiently to again bring the magnet up to its original strength, when it will again pull down the armature and lock the gearing. A too rapid movement of the parts is prevented by a small fan, shown in fig. 2. When the carbons are drawn apart to a considerable distance and then allowed to approach, this fan will revolve with great speed, and its wings will be spread by centrifugal action to their fullest extent; but when the carbons touch, and the electrical current is established, its speed is much reduced as the larger armature C is drawn down, and it remains in that position while the circuit is complete. The armature has an attachment which is brought within the field of the extended wings, but it cannot reach them when they are closed. The fan, when engaged by the attachment, can revolve only a quarter turn at a time and at a very slow speed.



When the ratchet F on the fan shaft is unlocked, it can revolve rapidly only when the current is broken, and when it is released to feed the carbons to an already established arc it can only turn at a speed a little faster than the actual consumption of the carbons. Should the arc be broken, or the light be extinguished from a high wind or other cause, the large armature C will be liberated, and by bringing the lower carbon against the upper carbon it re-establishes the arc instantly. A too rapid movement is prevented by a controlling chamber or dash pot in the bottom of the lamp. All of the comparatively heavy work of separating

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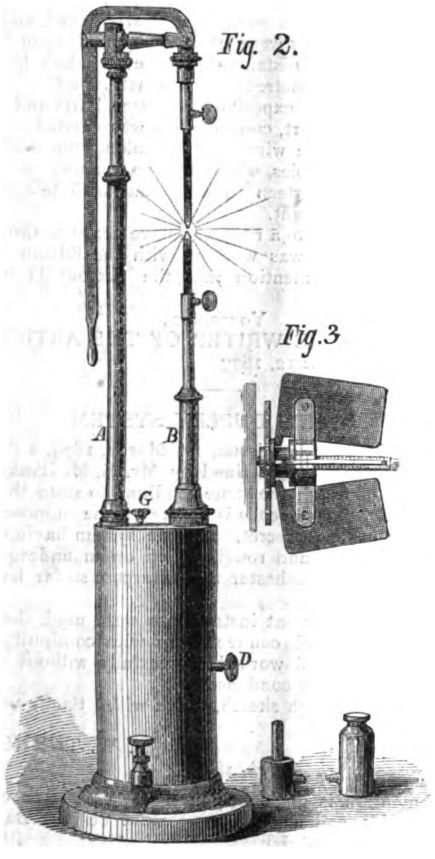
the carbons and re-establishing the current is done by armature C, while the smaller armature E has only to lock and unlock the train of gearing.

As the distance to be travelled is very slight, and the work to be done so light, but very little change in the electro-motive force of the current is required to stop or start the feeding of the carbons. The tension of the spring that opposes the magnetism can be adjusted from the outside of the case to balance its pressure against a current of any strength. Where great nicety and steadiness are required, this lamp seems well adapted to meet all requirements. It is small and compact, and appears a very substantial and beautiful piece of mechanism.

A less expensive form of lamp has been devised by the same inventor. In this lamp both carbon

Fig. 2.



holders are supported by a cord. As the upper or positive holder descends it draws the cord over a pulley and raises the negative just one-half the distance travelled by the positive. When the wires are properly connected and the carbons are in position, the top holder may be allowed to run down until the two carbons meet. This establishes the circuit and excites the axial magnet in the bottom of the case, when the core is drawn into the helix, and the two carbons, through the medium of levers, are drawn apart until the magnetism and tension of the spring balance each other, and as the carbon is burned away the arc is lengthened, the magnetism reduced, when the core is drawn out of the spool, thus feeding the carbons together as they are consumed until the parts have reached a position where the ratchet on the lower lever is beyond the reach of the pawl, then the core descends and the ratchet revolves, when the carbons take a new position, and the feeding goes on as before. The ratchet wheel is prevented from turning more than one tooth at a time by a spring at the end of the lower lever. The pull of the rack is opposed to the spring, and when the pull is reduced by the disengagement of a ratchet tooth the lever, and with it the ratchet, are forced downward, and the succeeding tooth is caught on the pawl. The core on which the magnetism operates is connected with the rack by compound levers, so that by changing the position of the connecting link the leverage can be readily adjusted.—From G. B. PRESCOTT'S *Telephone, Electric Light, &c.*

THE TELEGRAPH IN DENMARK.

By CARL HANSEN, Fredericia, Jutland.

TWENTY-FIVE years have passed since the first Danish electrical telegraph line was opened for public correspondence. It was on the 1st of February, 1854, that a line 280 miles long was opened between the two terminal points, Elsinore and Hamburg; but, besides these two terminal stations, there were intermediate stations at Copenhagen, Corsoer, Nyborg, Fredericia, Flensburg, Rendsburg, and Altona, besides three postal stations of a certain importance. On the 1st of January, 1855, a Danish controlling station was established at Helsingborg, in Sweden, to control the Swedish correspondence that passed through Denmark; a cable having in the meantime been laid out from Vedbek, near Elsinore, to Helsingborg. A wire was then put up from Helsingborg through Seeland, Fione, and the two duchies to Hamburg, where the messages for Germany and England were exchanged. In the year 1856 a new line through the eastern part of Jutland was built between Frederikshavn and Hamburg, and at the same time a short wire was put up from Copenhagen to Frederiksborg. On the new line in Jutland, which was 270 miles long, stations were established in all the greater towns of the east of the Peninsula in the following year, and in Seeland and Fione two new lines were erected, with a station at the town of Odense. In 1858 the controlling station at Helsingborg was removed to Copenhagen as a new line had been erected for the Swedish traffic. Private companies were very active in erecting telegraph communications, and Denmark is indebted to those companies for the many stations that were opened during a short period. These lines were from Nyborg to Svendborg, Rudkjóbing, and Marstal—the two last towns, which are situated on the islands of Langeland and Aeroe respectively, being connected by cables—from Hobro to Skive, Viborg, Nykjóbing on Morse, and Thisted, and the lines from Aarhus to Silkeborg, and from Fredericia to Middeefart and Assens. In 1859 Flensburg was put in direct connection with England *via* Toenning and Vesterhever. A line from Copenhagen to Hamburg, with a two-wire cable from Fione to Als, was established in 1860-61, so as to have more lines for the increasing traffic with foreign countries. In 1861 a new line of a length of 148 miles was built, which connected all the towns of western Jutland from Flensburg to Lemvig; and many new private companies got a licence to erect stations, of which the westerly towns of Seeland were the most important. All these private lines and stations

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were bought by the Government on the 1st of February, 1871.

The loss of the duchies of Schleswig and Holstein diminished the total length of the Danish telegraphs by about 400 miles, and the stations by 16, including the two great stations at Flensburg and Hamburg, which were in direct connection with Copenhagen as well as the most important Swedish towns, and forwarded all the traffic abroad from Denmark, Sweden, Norway, and in part also from Finland. Sweden had then no other connection with Germany. At present it has a cable from Trelleborg to Rügen, one from Gothenburg over the northern extremity of Jutland (land wire) to Newcastle, and one from Grislehamn (Stockholm) to Nystad Finland—the two last belonging to the Great Northern Telegraph Company.

The war of 1864 with Germany for some time kept all development of the Danish telegraph system at a standstill; but a few years after, in 1869, the work commenced again by connecting Bornholm into the system. Meanwhile, cables were laid down to England (Newbiggin, near Newcastle) in 1868, and to Norway (Arendal) in 1867. In 1869 the Great Northern Telegraph Company connected Russia (Libau) with Fredericia *via* Bornholm (land line on this isle). Fredericia now became the head office for the traffic to and from these countries; and in 1873 it was also connected by a great Great Northern cable with Calais *via* Fanó, and with Gothenburg *via* Frederikshavn. New lines between small towns had also been built, and the three following semaphoric stations were installed: viz., Hirtshals (Skagerak), Hanstholm (North Sea), and Hammershus on Bornholm, as well as four stations, which are only open in severe winters for postal use; viz., Masnedó, Sprogó, Knudshoved, and Slipshavn.

Copenhagen has a great local traffic, but is of little importance as a transit office. It is Fredericia that must be regarded as the most important of all the telegraph stations in Northern Europe, from an international point of view. No other town is, as far as I can learn, connected with so many foreign countries through cables as this cosy little Danish town. For this reason the *employés* must know and speak several languages to a certain degree of proficiency, for they correspond with Paris, *via* Calais; with Newcastle, *via* Newbiggin; with Russia, *via* Liban; with Sweden, *via* Gothenberg; with Norway, *via* Arendal; and, finally, with Germany, *via* Hamburg, Flensburg, and several other towns. Most of the telegraphic traffic between Russia, China, Sweden, and Norway (the French and German) on one side, and England, France, and a portion of the United States' traffic to China on the other, pass through this town, which is unknown to the world at large. At Fredericia there are about 70 clerks, and 30 to 40 instruments, of which the most part are inkwriters of Siemens-Halske's improved system. The cables are worked by Wheatstone's instrument.

The Danish telegraph lines comprise 1789·64 English miles, including 4790·84 miles of wire. The whole staff at the end of last year numbered 360, of which there are two engineers; 17 managers or superintendents, who control the larger stations; 25 clerks-in-charge, of whom many are managers of smaller stations; 128 clerks divided into 5 classes; 104 beginners; and 90 postmasters or other people who have a station to take care of, but have other business besides.

The Swedish telegraph, including land lines and cables, amounts to 776·2 Swedish miles, comprising 1904·7 Swedish miles of wire. The total number of Government stations and railway stations is 705, of which 179 are Government and the remainder are railway stations.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

GOWER'S TELEPHONE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In an article on the above in your last issue, I stated (wishing to be rather *under* than *over* the mark in my estimate of its powers) that words imparted at the sending end were audible several yards from the receiving telephone. My attention has now been called by the inventor to the following facts:—

1st. That at a recent meeting of the *Societe d'Encouragement* talking was distinctly heard all over a room 20 metres long and 10 metres wide. That airs played on a clarion were also clearly heard, and that Mr. Gower's orders were heard and acted upon by his assistants at the distant station, even when he (Mr. Gower) stood 12 metres from the instrument.

2nd. That in an experiment between Paris and Creil, 51 kilometres apart, conversation was carried on with ease, although the wire used ran along the main line (Paris-London) poles, which carry a number of wires, varying from fourteen to forty, and with telegraphic business at its height.

With reference to a rumour I have heard to the effect that Mr. Gower was working with the Edison transmitter, I may mention that the rumour is utterly incorrect.

Yours, &c.,
THE WRITER OF THE ARTICLE.

London, *March* 12, 1879.

A NEW DUPLEX SYSTEM.

SIR,—In your last issue, 1st March, 1879, a "new" Duplex system is explained by Mr. S. M. Banker. I must beg, through the same medium, to state that the idea of dividing the coils is not *new* as he supposes, nor has it been kept a secret, the same system having been proposed by me and roughly tried on an underground wire between Manchester and Liverpool so far back as May, 1873.

Two single current instruments were used, the coils being divided and connected up with continuity preserving keys, and worked successfully without either resistance coils or condensers.

I enclose a rough sketch, which will, I think, explain itself.

E. W. TURNER.

Liverpool, *5th March*, 1879.

[No mention is made in your letter or sketch of the moveable coil, which is a feature of Mr. Banker's system.—Ed. T. J.]

SIR,—If I correctly understand Mr. Banker's arrangement, a description of which appeared in your last number, there seems to be two objections to the system.

1. When the apparatus is not working both poles of the battery are to earth, having one of the relay coils in circuit.

2. The act of pressing down the key, *short circuits* the battery for an instant, and a current sent at the same moment from the opposite end of the wire is of itself insufficient to work the relay. The result would probably be a *splitting* of the marks.

Has the system ever been tried?

March 8, 1879. DETECTOR.

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Notes.

THE ELECTRIC LIGHT.—The experiment with the electric light in Holborn has come to an end, and the City Commissioner of Sewers have recommended the report thereon to be printed.

THE lighting of the British Museum Reading Room by twelve Jablochkoff lights, on posts some 15 ft. above the floor, is another success, and has evoked the applause of the public. Last week the room was kept open for readers till 7 p.m. to test the light for reading purposes. A very faint hum is heard from the lamps; but it is soon disregarded. The smallest print can be easily read, and any flickering of the diffused light that there may be is not at all troublesome to the eyes.

THE cost of lighting the Albert Hall, which is fitted with four Siemens' lamps hanging from the dome and four Jablochkoff candles mounted on posts in the orchestra, fed by Siemens' new alternating current dynamo-electric machine, is stated at 12s. 6d. per hour, exclusive of interest on working capital.

THE British Electric Light Company have lit the Liverpool Landing Stage temporarily with electricity by means of two Gramme machines and two Serrin lamps. It is expected that ocean steamers will profit by this illumination of the Mersey. Several of the Havre and New York steamers now carry a flashing electric light at the mast-head.

MR. LATIMER CLARK, who to his other gifts adds that of lecturing, gave an admirable lecture on the electric light at the Eyre Arms, on March 5th. He was assisted by Dr. Muirhead, and all the well-known lights were exhibited. In his peroration Mr. Clark declared his firm faith in electric lighting as confined to streets and halls. He concluded: "How astonishing then are the wonders of electricity. How fortunate are we of this generation in being permitted to live in a period of such progress. Compare the world of to-day with what it was when many in this room were born—no gas, no steam-engines, no electric telegraphs, no photography, no railroads, no steamboats, no telephones or microphones. How proud ought we to feel, too, that our own little island has been the birthplace of most of these wondrous discoveries which have so changed the face of the world. Science has, doubtless, great triumphs in store for us; but, just as no previous generation has witnessed such advances as ours, so it is not conceivable that any future generation can see such stupendous changes as we have witnessed. The sceptre of the world has departed successively from India, from Egypt from Athens, and from Rome, ever travelling westward, and it may one day depart from Britain to travel still further towards the setting sun. But wherever it be found, as long as civilisation exists, and as long as mankind has a history, be it thousands or be it ten thousands of years hence, men, and even children, will be taught to speak with reverence of the day in which we now live—of the age of the great Queen Victoria—and to point out on the map the little sea-girt island in the northern seas, in which these wondrous discoveries had their birth."

THE TELEPHONE.—Gower's telephone, which we illustrated in our last, has been fitted up in the bureau of M. Cochery, Minister of Posts and Telegraphs, at the Havas Agency and at the *Société de l'eclairage electrique*, Paris.

WE hear that M. Du Moncel has brought out a new telephone.

MR. EDISON'S nephew has brought his uncle's new telephone to London. It is on the principle of the electro-motograph.

ADJUSTING BELL'S TELEPHONE.—It is well known that the Bell telephone requires adjustment from time to time owing to changes of temperature, humidity, and so on. This is ordinarily effected by means of a regulating screw which moves the magnet to or from the diaphragm; but as these screws have no indicator to them the work of adjustment is, to a certain extent, blindly done. A plan of regulation introduced by M. Champvallier, of the Ecole Artillerie, Clermont, France, has proved very convenient. It consists in fitting the regulating screw with a pointer and graduated circular scale; so that the best position of the screw-head can be marked. On adjusting the telephone separately to give the best hearing and speaking effects, and noting the corresponding positions of the pointer, a position midway between these two points is chosen.

SIEMENS' TELEPHONE CALL.—Dr. Werner Siemens forms a simple telephone call by inserting a whistle or reed pipe into the mouthpiece of the telephone when it is desired to call attention. On blowing into this whistle the sound agitates the telephone diaphragm in front of it.

A MICROPHONE CONCERT.—The wonderful invention, the microphone, has been put to a novel use in the city, experimentally. A few days ago Superintendent Eckert, of the Telephone Exchange, placed a microphone at each end of the stage of the Grand Opera House, and connected them with wires leading to the Central Exchange. Parties having lines in connection with the Exchange were notified that they would be treated to a novel concert, and at the appointed time a large number, in various parts of the city, took advantage of the invitation. The action of the microphones was marvellous. The most delicate strains of the orchestra were heard, and selections readily recognised. The words of the actors were distinguished, and, in some instances, the players voices recognised, so perfect was its articulation. Many in the suburbs of the city enjoyed the treat, and regarded the entire programme as very satisfactory, considering that no cost of admission was charged for the entertainment. This is a verification of the prediction we made some time ago. —*The American Inventor.*

THE PHONOGRAPH.—We hope to give an account of Messrs. Preece and Stroh's researches in vowel sounds in our next.

MAGNETISM AND POLARISED LIGHT.—An interesting experiment has recently been made by M. Henri Becquerel. Two rays of light polarised in the same direction were passed through a flint glass lens, which were subjected in opposite directions to the action of an electro-magnet, as in Faraday's experiment. On issuing from the lenses the two rays were brought into interference with each other; and it is observed that when the current passes in the electro-magnet the fringes are displaced in one direction, while when the current is stopped they are displaced in the opposite direction.

THE short cables from Newark to Heligoland and from Trinidad to Demerara are interrupted. Para is

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reconnected to Pernambuco on the south, but no attempt has of late been made to restore communication with Cayenne and Demerara on the north.

THE CAPE CABLE.—The Eastern Telegraph Company have offered the Government the 1,400 miles of Australian cable now shipped, but the Government refused the guarantee against accident which the company stipulated for, and the negotiations were broken off. The India Rubber Company have offered to make and lay a cable within this year.

PUBLIC complaint has been made of the errors in the names of the killed and wounded in the Zulu war, as telegraphed from St. Vincent.

APROPOS of the Cape Cable, our French contemporary *L'Electricite* calls for cable communication between France and her colonies of Senegal and New Caledonia.

JAPAN TELEGRAPHY.—We learn from the *Journal Telegraphique* that Japan has joined the St. Petersburg Telegraph Convention, having adopted the extra-European rules and tax per word, without conditions as to minimum of words. The cost of a message in Japan is fixed at 40 Mexican cents., or about a shilling per word.

THE International Telegraph Conference will meet on June 10 in London, and not on June 2 as at first arranged.

FOR three years the German Telegraph Administration have published statistics of the faults on their air lines, a plan which is worthy of imitation by all other telegraph managements. In 1878 some 382 posts were broken on 17,700 kilometres of wire, 1,097 broken wires on 15,700 kilometres, 2,651 leakages on 34,500 kilometres, 1,342 damaged insulators on 25,000 kilometres, and 742 loose wires on 10,800 kilometres. These figures show a remarkable reduction of mishaps as compared with the previous two years.

TASMANIA has 850 miles of telegraph line connecting 46 stations, besides being connected by cable to Australia.

ELECTRIC CAR SIGNAL.—A trial will soon be made of a new signal recently patented by Mr. I. A. Sherman and Mr. C. E. Mees, of Louisville, Ky. The first-named gentleman is an accomplished electrician, and is connected with the Louisville and Nashville Railroad. The invention consists in combining a signal device upon the locomotive with two conducting wires extending through the cars of the train, and terminating at the end of each car in adjacent contact plates, forming seats, together with a flexible cable having two insulated wires terminating in metal plates separated by a soft rubber block, to continue the circuit, but permitting it to be broken when the cars separate, and transmit a signal to that effect to the engineer. It can be applied to freight as well as passenger cars. The cost will be something more than that of the system now generally in use.—*Nat. Car-Builder*, U.S.

CLERAC'S TUBE.—We are informed by Count Du Moncel that the reasons why he did not publish an account of Clerac's tube in his works are that M. Clerac is an officer of an administration which does not like its functionaries to publish their inventions, and because he (M. du Moncel) did not think that rheostats founded upon pressure did not give results constant enough to be classed as measures of resistance. The same degree of pressure on the same rheostat does not give the same resistance at all.

EFFECT OF INDUCTION CURRENTS ON THE SPINAL CORD.—Dr. William Miller Ord, Physician to St. Thomas's Hospital, has been investigating the effects of strong induction currents on the spinal cord of dogs. The dogs were killed by chloroform, and the cords being quickly exposed, were subjected to the currents for different periods and in different directions. Dr. Ord observed that the cord broadened in those parts through which the currents passed longitudinally, and narrowed where transverse currents were applied. The following are his conclusions as communicated to the Royal Society:—1. That, in young dogs, the protoplasmic constituent of the gray matter contracts *en masse* under the influence of strong faradaic currents. 2. That it contracts unequally and irregularly by reason of its unequal and irregular sectional area, causing thereby condensations at certain points—notably in the anterior horns and around the central canal—and rarefaction at others—notably in the middle of each crescent; such rarefaction going on sometimes to rupture of tissues. 3. That nerve-corpuscles contract in various degrees according to the strength and duration of currents, and that while they tend in contraction to become spherical they also tend to become vacuolated. 4. That the vessels are in some places strongly contracted and empty; in others dilated and filled with blood clot, having the appearance of embolus. 5. That the appearances correspond so decidedly with appearances in chorea and tetanus as to give ground for the supposition that contractions, such as are produced by electricity, do actually occur during life under the effect of nervous shock, and may be phenomena causal or associate of disease.

ELECTRICAL ENGRAVING.—M. Bellet has developed a plan for engraving by means of electricity. The drawing to be copied is placed over the metal plate, and a fine metal point emitting a succession of sparks capable of perforating the paper is caused to trace over the lines of the sketch. The discharge from point to plate severs the intervening paper. If, then, the greasy anti-corrosive fluid be applied to the surface of the paper, it will seek through and form lines on the metal plate following the lines of the drawing. On the application of acid to the plate, these greasy lines will protect the metal and form the salient parts of the engraving. Mr. Lascelles W. Scott has recently devised a somewhat similar electric pen.

ELECTROTYPING THE NERVOUS CENTRES.—The process by which M. Oré prepares his beautiful copies of brain and other nervous ganglions which attracted so much attention at the Paris Exhibition last year, has been described by him to the French Academy of Sciences. It consists in melting gutta-percha in a deep box, and plunging therein the brain or other organ to be modelled. The gutta-percha completely surrounds the object, and, on hardening in the air, it is cut into sections from each of which the brain matter is taken away, leaving a clean mould of gutta-percha representing the external form of the organ. The interior of this mould is then coated with plumbago, and an electrotype of copper or nickel made of it. This electrotype is thick enough after three or four days electro-deposition.

A ROYAL MEDAL has been awarded by the Royal Society to Mr. John Allen Broun for his investigations during thirty-five years in magnetism and meteorology.

TERRESTRIAL MAGNETISM.—One of the most remarkable results discovered by Mr. Broun is the fact that the

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variations from day to day of the earth's daily mean horizontal force were nearly the same all the world over. He finds certain oscillations in these daily means which were due to the moon's revolutions and others having a period of twenty-six days: the latter he considers as due to the sun's rotation. It results from these investigations that the observed variations of the earth's daily mean horizontal force have been represented with considerable accuracy in all their marked features by the combination of the means calculated for these different solar and lunar periods. During the discussion of these periods Mr. Broun found that the great magnetic disturbances were apparently due to actions proceeding from particular points or meridians of the sun, a fact of very great importance. In meteorology he has shown the apparent simultaneity of the changes of daily mean barometric pressure over a great part of the globe, and he has likewise discovered a barometric period of twenty-six days nearly. He was also the first to commence and carry out during several years a systematic series of observations of the motions of clouds at different heights in the atmosphere; and, lastly, he has found certain laws connecting together the motions of the atmosphere and the directions of the lines of equal barometric pressure.

HÉRAUD'S BATTERY.—The poles of this cell are zinc and carbon, the exciting liquid hydrochlorate of ammonia, and the depolariser is mercurous chloride or calomel. When the circuit is closed, the hydrochlorate of ammonia forms zinc chloride with evolution of ammonia and hydrogen, which appear at the positive pole. The hydrogen reduces the calomel, producing metallic mercury, hydrochloric acid, and, consequently, hydrochlorate of ammonia. The zinc is suspended amidst the solution at a distance of several centimetres from the bottom. The carbon is, with its surrounding solution, contained in a linen bag, and the mercury, which is reduced at the carbon pole, falls by its weight through the linen to the bottom of the cell. In order to prevent evaporation of the ammonia, the cell is closed with an air-tight cork. The cell is held to be constant: its electromotive force after 246 days, during which it was used for a variety of purposes, being 66 per cent. of the original value. The original electromotive force is 1·45 times that of a Daniell element. The original resistance is given as equal to the resistance of 75 metres of telegraph wire.

HYDRO-ELECTRICITY AND HYDRO-MAGNETISM are the names given by M. C. A. Bjerknes, of Christiania, to certain attractions and repulsions observed by him between bodies in water. The bodies he experimented with were oscillating glass bells inverted in the water, and by means of tubes and an air-pump, pulses of air, causing pulsations in the water, could be sent into the bells. When the pulsations in the two bells were concordant, attraction ensued, when discordant, repulsion. A neutral or critical point was also observed in certain cases, and lateral deviation could also be produced. We do not see why this effect should be laid at the door of electricity since it appears to be quite mechanical.

INDUCTION IN TELEGRAPH WIRES.—M. H. de Meaux has pointed out in a note to the French Academy that the idea held by some electricians that a cylindrical conductor enclosing a wire, and in connection with "earth," is a protection against induction currents set up in the wire by currents travelling in neighbouring wires, is quite fallacious. The idea seems to have arisen from the assumption that electro-static induction is similar to electro-dynamic induction. M. Meaux points out the dissimilarity of the two phenomena. Fresh light was thrown upon this subject by Prof. Hughes at the Society of Telegraph Engineers' meeting on March 12.

Review.

The Speaking Telephone, Electric Light, and other recent Electrical Inventions. By G. B. PRESCOTT. London: E. & F. N. Spon.

IN writing this book, the author has had three objects before him: firstly to write a book, secondly to advertise Mr. Gray's claim to be recognised as the first and true inventor of the speaking telephone, and thirdly to support the claim of Mr. Edison to the discovery of the microphone. For a servant of the great telegraph monopoly of the United States, the Western Union Company, these are worthy enough objects when they can be effected without sacrificing truth or honesty of thought.

Mr. Prescott has already made a deservedly wide reputation as a writer of electrical works. His style is indeed not of the highest, nor is his grammar of the best, but it is sufficiently lucid for practical purposes, and he takes a vast deal of pains, and spares no expense, to turn out a comprehensive and well illustrated compendium of the matter he deals with. He thus renders a great service to students of electrical science, a service which we cordially applaud.

The present work contains much valuable information on the telephone, phonograph, and microphone, as well as on the electric light. Much space is occupied in presenting Gray's claims to the invention of the speaking telephone. His 1874 sulphuric acid and water telephone containing the idea of a speaking telephone, is illustrated first; then Bell's 1876 electro-magnetic telephone is illustrated, and the two are contrasted. Now, at page 71, in a foot note, it is implied that Bell only succeeded with his telephone when he applied the apparatus of Gray, invented two years before, and as the wording of the footnote is such that persons ignorant of the subject might attach greater importance to the statement than was perhaps intended, it should be pointed out that Gray's liquid telephone is not, and never was, a practical success, and that the electro-magnetic apparatus he employed was used only as a *receiver*, whereas the great merit of Bell's consisted in the use of an electro-magnetic *transmitter*, and making the speaking telephone an actual fact. Mr. Gray was probably the first to conceive of a theoretically correct speaking telephone; but to Bell belongs the honour of achieving one. More than this, Bell did not simply succeed, where Gray failed, by adding some happy improvement to Gray's plan. Bell's telephone was arrived at by a totally different line of reasoning, and further, it is a totally different instrument. Bell's is entirely electro-magnetic, Gray employs a battery. It was an *accident* that Bell's more successful transmitter happened to be like Gray's earlier receiver, not a plagiarism. Had the latter never existed at all, Mr. Bell would still have arrived naturally at that form, for it is simply the next refinement on the prior steel tongue apparatus. Once for all, Bell's telephone is quite a distinct system from Gray's, and what is more, it succeeded where Gray's failed.

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Mr. Prescott fulfils the third object of his book in a far more sweeping manner than the second. It is amusing to find all the little experimental waifs and strays of Mr. Edison's carbon telephone researches marshalled by him in an imposing array, and dignified by the name of "microphone." This method of trying to establish a claim to an invention is more worthy of itinerant jugglery than of science.

At page 534 a sketch of Mr. Edison's carbon buttons is termed a "microphone," and we are told that "instruments of this nature have since become known as microphones, though it is *not probable that faint sounds were ever augmented throughout their agency, so that they could be easily recognised at a distance from their source.*" We were about to inform Mr. Edison that the figure in question does not represent a microphone, but the passage we have italicised saves us the trouble. That passage shows too well that Mr. Prescott does not know what a microphone is, and has never heard one. If Mr. Prescott has not himself heard minute sounds transmitted to a distance by a real microphone, why does he also disbelieve all the high authorities in this country who have? It is his misfortune that he hasn't, but one would expect that the overwhelming testimony of Europe would satisfy him. At page 536 Professor Hughes' discovery of the microphone is stated in these words: "In May, 1878, Mr. Hughes, of London, published some interesting experiments based upon Mr. Edison's discovery of the variable resistance of solid conductors when subjected to pressure." In penning this significant passage Mr. Prescott has deliberately set aside the fact which has been abundantly forced upon his notice of late, that the real discoverer of that quality of carbon was M. Du Moncel, as far back as 1856, and the demonstration of Professor Hughes that he was led to the discovery of the microphone and the sonorous property of "bad joints," not by the discovery in question (a discovery too which Professor Hughes knew about before Edison had begun to invent at all), but by the stress of wires. It is a strange method this of writing a scientific treatise. Let us hope it is not common in America.

In his section on the electric light, Mr. Prescott is a safer guide than in the other parts of his book. But a book which is innocent of the beautiful lights of Rapieff and Werdermann cannot be said to do justice to the subject. There is nothing fresh about Mr. Edison's light.

THE ELECTRIC LIGHT IN PARIS.—The Municipal Council of Paris has arranged with the *Societe Generale* to try the Jablochkoff light for another year in certain parts of Paris, and with the Parisian Gas Company to try their gas lighting for a year in certain other parts. The *Societe* will have sixty-two candles in the Place and Avenue de l'Opéra, fifteen in the Place de la Bastille, and six in the Pavillon des Halles. The Gas Company will have fifteen lamps in the Rue du Quatre-Septembre, each of large size, and furnished with a crown of eight burners, consuming 1,400 litres of gas per hour; nineteen lamps in the Place du Château d'Eau having eight similar jets a-piece, and fifty-eight having four jets, consuming about 800 litres per hour; and twenty lamps of eight burners each in the Pavillon des Halles. A thorough competitive trial of gas *versus* electricity for street lighting will thus be obtained.

New Patents—1879.

644. "Magneto-electric or dynamo-electric machines." J. F. WILES. Dated Feb. 18.

684. "Improved means and apparatus for producing light by electricity." M. A. WIER. Dated Feb. 20.

740. "Improvements in electric lamps, and in the method of and apparatus for regulating and controlling the same." F. MORI, C. E. HALLEWELL, W. MILNER, W. GRIFFIN. Dated Feb. 24.

749. "A galvano-magneto-dynamo electric machine.' C. DUBOS. Dated Feb. 25.

781. "Electric telegraphs." E. A. COWPER. Dated Feb. 26.

783. "Obtaining electric light." G. P. HARDING. Dated Feb. 26.

792. "Improvements in electric telegraphs, and in apparatus connected therewith." Sir C. T. BRIGHT. Dated Feb. 27.

801. "Auto-kinetic electric telegraph apparatus." L. M. DE BEJAR Y O'LAWLOR. Dated Feb. 27.

805. "Improvements in and relating to magneto-electric apparatus." W. P. THOMPSON (communicated by W. W. Gary). Dated Feb. 28.

806. "Telephones." J. IMRAY (communicated by C. Ader). Dated Feb. 28.

827. "Electric telegraphs." R. and M. THEILER. Dated March 1.

830. "Improvements in and connected with electric lamps." G. G. ANDRÉ. Dated March 1.

854. "Producing and converting electric force into motive power." H. POST, T. VARLEY. Dated Mar. 4.

863. "Electric lamps." C. D. ABEL (communicated by J. C. JAMIN). Dated March 4.

876. "Mode of and apparatus for producing light by electricity." J. B. SPENCE. Dated March 5.

872. "Improvements in and connected with street and other fire alarms." R. S. SYMINGTON. Dated March 5.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

2193. "Apparatus for producing induced currents of electricity, specially applicable to transmitting signals, &c." A. F. St. GEORGE. Dated June 1. 6d. This describes a telephone call, made by adding a second coil to the telephone, surrounding the first after the manner of the primary and secondary of an induction coil. A battery is connected up in series with the primary coil. The call is giving by starting a reed contact (which is in the primary circuit) into vibration.

2202. "Telephones." W. H. PREECE. Dated June 1. 6d. This consists in a method for transferring the received vibrations of a tone telephone to membranes in such a way as to increase the volume of sound given out. This is done by connecting the end of the vibrating reed of the tone telephone (which may be the elongated tongue of a polarised relay) to a tight membrane by means of a stretched wire, as in the toy telephone. More than one of these membranes or

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tambours may be vibrated from the same receiver in this way.

2281. "Distributing and regulating electric currents to work lamps." C. W. SIEMENS. June 7. 6d. This describes Siemens' current regulator, which we illustrated in last number.

2288. "Apparatus for refracting, reinforcing, and modulating sound." A. C. ENGERT. Dated June 7. 6d. This consists of the application of iron or other hard material in sheets, or spiral coils supported by spiral springs from the sounding body.

2385. "Electric telegraphs." E. A. COWPER. Dated June 15. 6d. This describes Cowper's telegraphic pen, which we illustrated in last number.

2396. "Telephones and apparatus employed in electric circuits." T. A. Edison. Dated June 15. 10d. This describes the telephone, in which a plate or body, against which the sound waves in the atmosphere act, is placed against a button of carbon in circuit with the line, so that the pressure of the waves on the plate vary the resistance of the carbon. Edison's microtasimeter is here also described. (See TELEGRAPHIC JOURNAL, Nov. 15th, 1878.)

2399. "Obtaining light by electricity." W. P. THOMPSON, (communicated by E. Reynier). Dated June 17. 6d. This describes Reynier's well-known electric lamp, in which a fine rod of carbon impinges on a rotating disc, the result being a very small arc or bead of light.

2401. "Apparatus for producing electric light." C. DUBOS. Dated June 17. 6d. This describes an electric lamp in which the wasting carbon is carried by an iron tube free to move in a hollow electro-magnet. The regulation is effected by passing the current feeding the light through the coil, and balancing the downward weight of the carbon against the upward pull of the electro-magnet on its iron holder. *Not proceeded with.*

2407. "Manufacture of articles produced by the electro deposition of metals." W. R. LAKE (communicated by J. W. Tufts, Medford, Mass., U.S.). 6d. This consists in freeing electrotypes from ragged edges by running a ridge round the border of the mould, which gives a corresponding groove in the electrotype. The latter is trimmed of its rough edge by cutting through this groove from the back.

2451. "Apparatus for lighting." MM. FRANZINI, Naples. Dated June 20. 6d. To increase the light from a lamp a semi-spheroidal water lens is placed in front and a whitened glass reflector behind.

2456. "Telephony." H. J. HADDAN (communicated by A. Mulhalland, Toronto). Dated June 20. 2d. This consists in the combination of a "condenser" with a telephone, in order to utilise a telegraphic circuit as a telephone line, without interfering with the use of the line for ordinary telegraphing; and in "earthing" a telephonic circuit at various points through a condenser in order to diminish the effect of external induction. *Not proceeded with.*

2467. "Electro-magnetic clocks." C. SHEPHERD. Dated June 20. 1s. To prevent stopping of electric clocks in event of the current failing, two or more separate circuits are arranged in connection with a single pendulum, each being capable of keeping the clock going, so that if one fails the other will suffice.

2477. "Apparatus for electric lighting." R. WERDERMANN. Dated June 21. 8d. Werdermann's electric light was fully described in the TELEGRAPHIC JOURNAL for Nov. 15th, 1878.

2554. "Telegraphic apparatus." C. A. BRAMÃO, Lisbon. Dated June 26. 8d. This consists of a double current electro-magnetic ink-writer, in which the armature moves to right and left of its zero position, forming right and left deviations of the zero line on the paper as in the siphon recorder.

Proceedings of Societies.

PHYSICAL SOCIETY.—MARCH 8th., 1879.

Prof. W. G. ADAMS in the Chair.

A new theory of the earth's magnetism was brought forward by Professor Ayrton which we give on another page.

Dr. J. Hopkinson then read an account of some experiments with the Quadrant Electro-meter, which showed that Clerk-Maxwell's formula for the sensibility of the electro-meter $(A - B)\left(C - \frac{A+B}{2}\right)$, where A and B are the potentials of the two pairs of quadrants, and C the potential of the needle, only holds good when C (the charge of the jar or needle) is less than 200 Daniell elements; above that a different law appears to hold. Dr. Hopkinson also remarked that any degree of low sensibility down to zero could be got from the electrometer by connecting a condenser to each pair of quadrants and adjusting their capacities.

Mr. F. D. Brown described his apparatus for maintaining constant temperatures and pressures. A constant temperature can be obtained if the pressure can be kept constant. The vessel in which the constant pressure is desired, communicates with an air pump by a pipe in which a moveable tap or valve is placed. By opening or closing this tap the pressure is regulated. This is effected by an electric clutch arrangement. A mercury anemometer sends a positive or negative current from a battery through the clutch according as the pressure is too high or low, and this current actuates the clutch to close or open the valve. The clutch consists of an axle driven by a turbine to get power to work the valve, and the current by means of electro-magnetism connects the tap to the axle, which then opens or closes it, as the case may be. In this way a pressure, varying no more than one-fifth millimetre each way can be obtained.

General Science.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

II.

Engines of Messrs. Ransomes, Sims, and Head.

MESSRS. RANSOMES, SIMS, AND HEAD, of Ipswich, have devoted a great deal of attention to the subject of motive power for electric-machines of various kinds.

Their engines have already for some years been used for electric light for lighthouses in Russia, New Zealand, and also for other purposes. At the Exhibition of Scientific Apparatus, held at South Kensington, in 1876, Messrs. Ransomes supplied one of their engines for driving the electric-machines shown in operation, and it gave the most universal satisfaction, on account of the perfect regularity of its motion.

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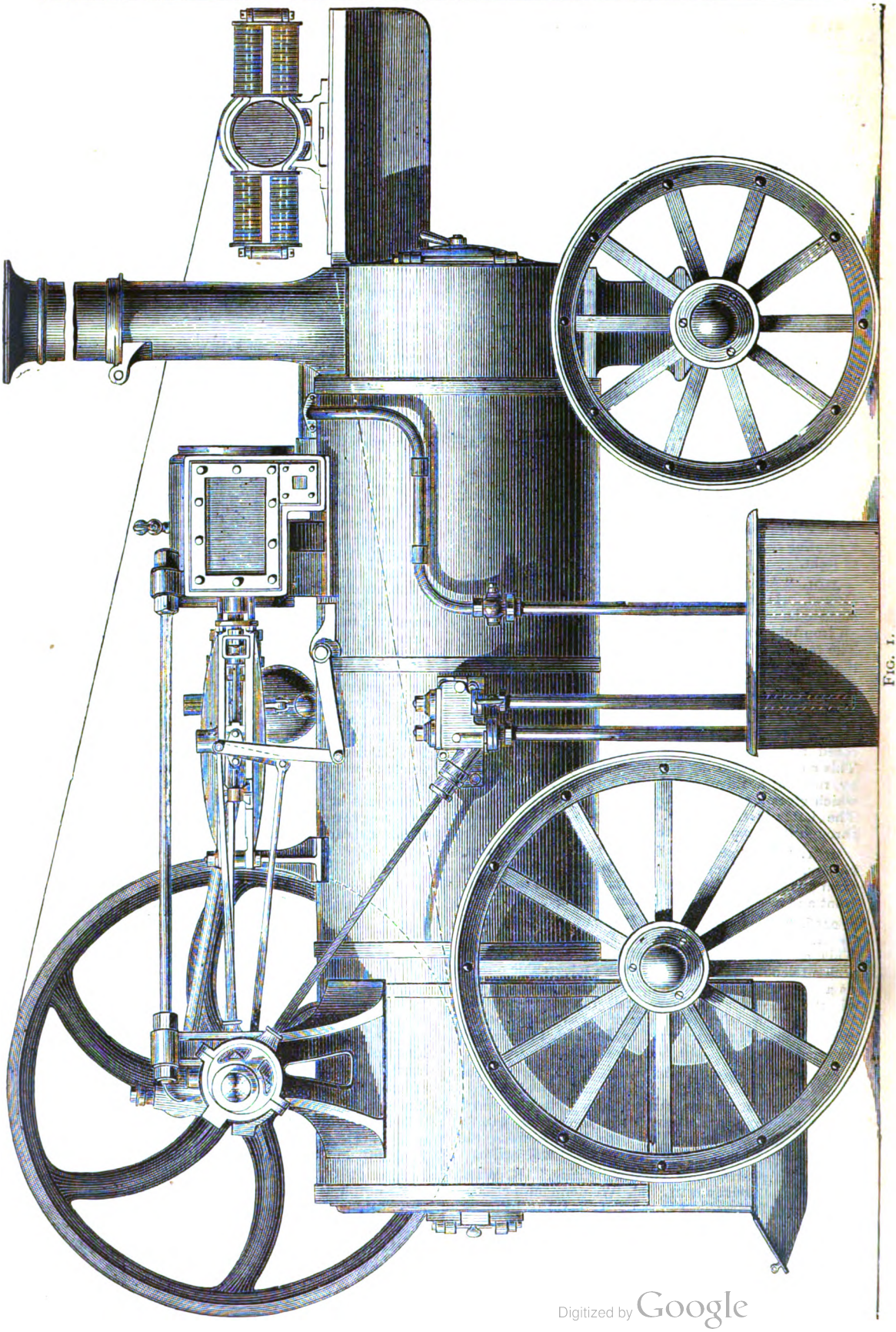

FIG. 1.

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It is well known that, in all cases, the greatest regularity in speed is required in the motive power for all electric-machines, and for this purpose Messrs. Ransomes recommend their Patent Automatic Governor Expansion Gear, which will regulate the movement of the engine to such a nicety, that the shafting of the factory, Messrs. Ransomes have been induced to pay great attention to the adaptation of their portable engines for electric purposes.

The engraving (fig. 1) represents one of Messrs. Ransomes, Sims, and Head's portable engines, which has been recently designed, and is specially

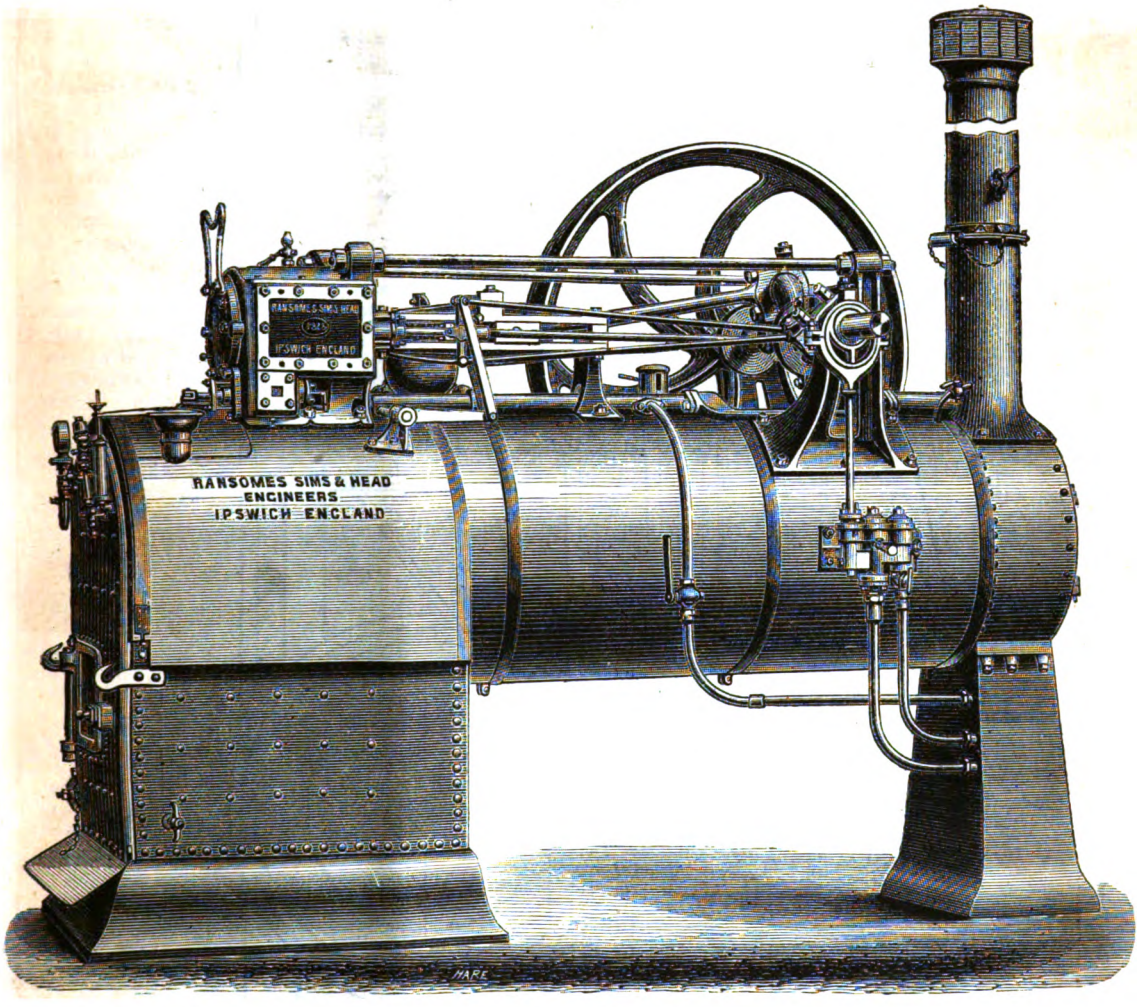

FIG. 2.

revolutions will remain without any perceptible fluctuation, even when the entire load is suddenly put on or thrown off. As it has also been found better in all cases to employ a small separate steam engine for the electric light, rather than to drive the machinery from the main engine or running arranged for driving a dynamo-machine. The electric-machine is carried on a bracket extended beyond the smoke-box, so that the whole apparatus, motive power, and electric-machine is self-contained, and being mounted on the four wheels of the engine, it is readily transported from place to place. The

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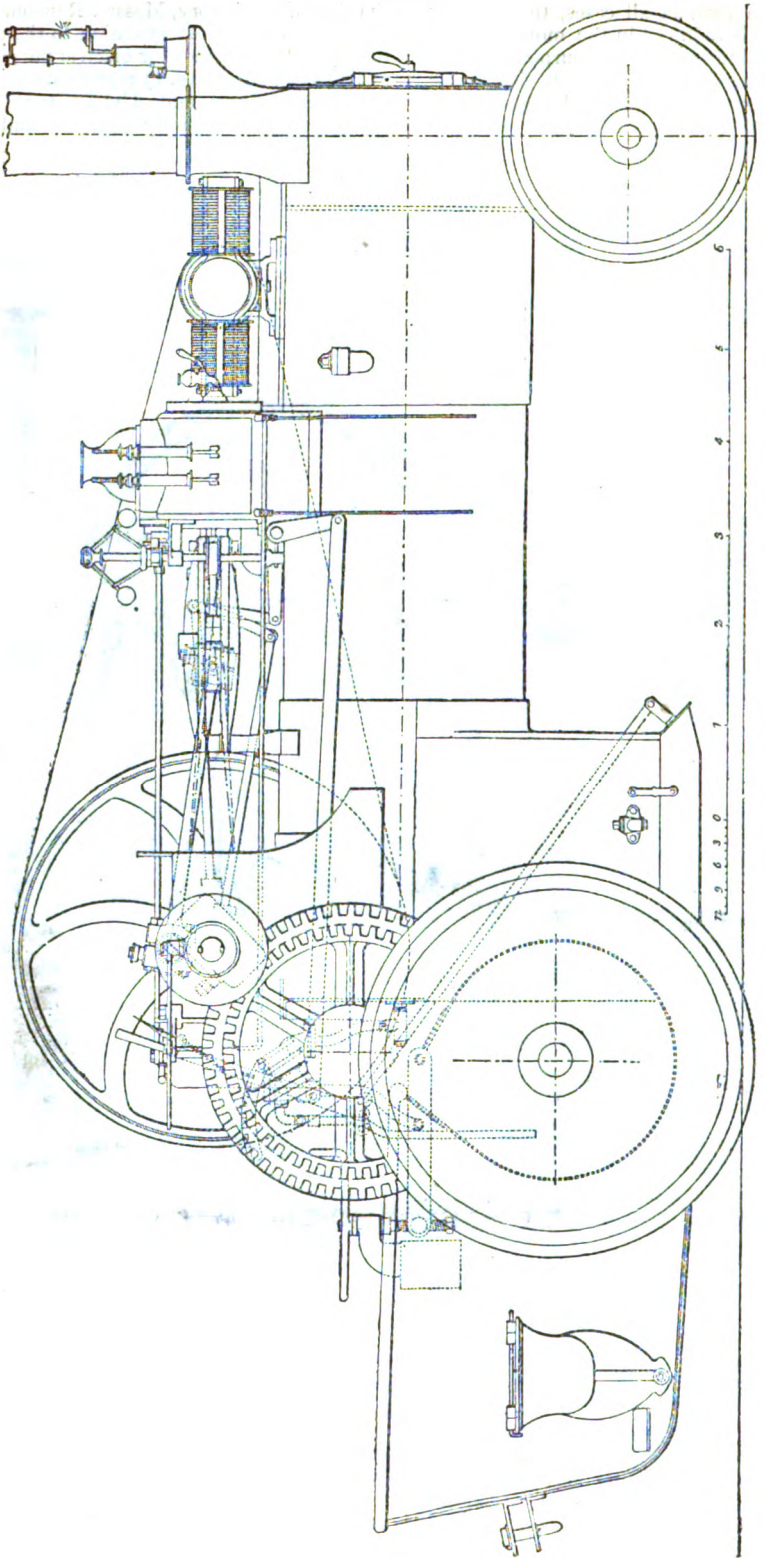

FIG. 3.

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platform can be arranged, when required, to carry an exciter and distributor, so that, by fitting on a second fly-wheel, both machines may be driven at one time.

It will be noticed that in this arrangement the cylinder has to be placed next the funnel, and the crank-shaft over the fire-box; but Messrs. Ransomes have also supplied engines of their standard pattern, in which a bracket for the dynamo-machine is fixed on the side of the fire-box, or they can attach a bracket to each side of the fire-box, so as to drive two machines at the same time.

The 6 horse-power machine, which we illustrate, has a cylinder 8¼ in. in diameter, with 12 in. stroke, and a speed of 140 revolutions a minute. With a steam pressure of 80 lbs. per square inch, cut off at about half-stroke, this engine will develope about 30 indicated horse-power, and the coal consumed under ordinary circumstances would not be more than about 3 lbs. per indicated horse-power per hour, according to quality of coal.

For the experiments now being carried on by the Metropolitan Board of Works in lighting the Thames Embankment by electricity, Messrs. Ransomes have supplied a 20 horse-power portable steam engine, which is fitted with the patent automatic governor, and has been much approved, and the excellent working and regularity of motion in this engine has contributed greatly to the success which has thus far attended the experiments in question.

This engine has two cylinders each of 10 in. diameter, with 13 in. stroke, and makes 140 revolutions a minute. It is mounted on cast-iron pedestals or saddles, instead of wheels, which gives great steadiness.

The engraving (fig. 2) shows one of Messrs. Ransomes' simple cylinder engines on pedestals, and fitted also with the patent automatic governor expansion. These engines are made from 4 to 20 horse-power, and they may all be had either on wheels or on pedestals.

The engraving, fig. 3, shows Messrs. Ransomes' Traction Engine (as used for agricultural purposes) arranged for driving an electric light for railway purposes. The ordinary wheels have been replaced by flanged wheels to suit the rails and the engine, which is of very light but strong construction, and can be run from place to place at speeds of 1½ or 3 miles an hour. This arrangement of railway engine and light will be found most useful for lighting up works at night on the permanent way, or for repairs, or inspection of tunnels. The dynamo-machine is fitted to the front part of the boiler between the cylinder and furnace, and is driven by strap from the fly-wheel. The light which may be of any system preferred, is intended to be placed in front of the smoke box at a height most convenient.

When the engine is travelling on the line the dynamo-machine is driven by the strap from fly-wheel as before mentioned, and the light is diffused along the road. When, however, it is necessary to stop in order to direct the light to some particular spot, the driving wheels are readily thrown out of gear, so that the engine ceases to be locomotive, the power being employed only for driving the dynamo-machine.

During the day the engine can be used for driving saws or pumping, or any other description of work.

City Notes.

Old Broad Street, March 12, 1879.

ON the 4th inst. the fifteenth annual ordinary meeting of the directors and shareholders of the Telegraph Construction and Maintenance Company (Limited) was held at Cannon Street Hotel, Sir Daniel Gooch, Bart., M.P., chairman, presiding. The report, in addition to the facts mentioned in the abstract contained in our issue of March 1, mentioned that the principal operations carried out by the company during the year 1878 were:—The laying of two sections of the Western and Brazilian Telegraph Company's cables on the coasts of Para and Maranham in the Brazils, amounting to 565 nautical miles, in accordance with the terms of a contract entered into with that company. An endeavour to repair the Anglo-American Company's cable of 1866, which proved unsuccessful, the decayed condition of portions of the outer covering rendering it impossible to raise the cable, except in short lengths. Two of the company's ships were employed on this operation between May 25 and July 27. The manufacture and laying of a cable for the Eastern Telegraph Company between the island of Cyprus and Alexandria, and the manufacture of certain lengths of cable to enable the company to duplicate and connect up portions of their system with the islands of the Levant and Constantinople. The manufacture of 289 miles of cable for Her Majesty's Government. The total quantity of cable manufactured during the year was 2,631 miles. The North Woolwich works, lately the property of W. T. Henley & Co. (Limited), and on which this company held the first mortgage, had been legally transferred to, and were now in possession of the company. The shares of the Black Sea Telegraph Company had been transferred to the Eastern Telegraph Company, and the cable from Odessa to Constantinople now formed part of its system. The company's debentures had been renewed on the same terms for a period of five years from January 1, 1879. The factories at Wharf Road and East Greenwich were in thorough working order. To replace the steamship *Hibernia*, the steamship *Scotia* had been purchased, and she, together with the *Calabria*, was undergoing extensive alterations and improvements, which, when completed, would place the company in possession of four large and efficient vessels, equal to the performance of any cable-laying operations that might offer.—The Chairman moved the adoption of the report.—Mr. Rawson (Director) seconded the motion.—Mr. Abbott, having complained that the chairman was difficult to draw out, said he would like to see a portion of the large balance added to the reserve fund.—The Chairman pointed out that their success had depended on their having the free use of large floating capital, and asked what would be the use of putting money in the reserve fund only to draw it out again.—Dr. Laurie: I want to know whether the company has received a commission for laying down cables to South Africa.—The Chairman: The Board are not able yet to supply details in matters of that kind. Negotiations have taken place, and are in progress. What the result will be you will know later on. At present there is no final agreement. (Hear, hear.)—The motion having been carried, Sir George Elliot, Bart., and Mr. Philip Rowson, the retiring directors, were re-elected, and Mr. J. Ball and Mr. Gane were appointed auditors for the year ensuing.—Before the meeting separated the secretary made an announcement relative to the second bonus trust, stating that there remained in the hands of the bankers £1,000 on this account, and the supplementary sheet of coupons could be obtained at the office.

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The board of directors of the Indo-European Telegraph Company (Limited) determined at their meeting on the 10th inst. to recommend to the shareholders the payment of a dividend for the six months ending December 31, 1878, of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year 1878, free of income tax; the dividend to be payable on and after the 1st of April next.

The report of the directors of the Direct United States Cable Company, Limited, for the six months ending 31st December, 1878, to be presented at the Third Ordinary General Meeting of the company, states that "the revenue for the half-year, after deducting out-payments, amounted to £89,943 14s. 8d. For the corresponding half year of 1877, the amount of revenue, after similar deductions, was £84,217 12s. 10d. The working and other expenses, interest on debentures of the old company and income tax, amount to £21,748 9s. 11d., leaving a balance of £68,195 4s. 9d. as the net profit for the half-year, making, with £2,933 3s. 7d. brought forward from the previous half-year, a total of £71,128 8s. 4d. In the corresponding half-year of 1877, the expenses and payments above mentioned, and cost of repair incurred during that period, amounted to £25,046 2s. 10d. Interim dividends of 1¼ per cent. each of the quarters ending 30th September and 31st December, 1878, together amounting to £30,355, have been declared and paid. A sum of 32,500 has been added to the reserve fund (thereby increasing it to £73,139 14s. 9d.), and a further sum of £3,000 has been written off the preliminary expenses, leaving a balance of £5,273 8s. 4d., which has been carried forward. The debentures of the old company have been paid off. The arbitration proceedings between the liquidators of the old company and Mr. Loeffler, one of the dissentient members, have extended over a period of 10 months. It is with much satisfaction the Directors state that the proceedings were closed on the 5th February last, and they now await the Arbitrator's award. The Muirhead Duplex System has been applied to the main cable." The meeting is to be held on 21st inst., at the City Terminus Hotel, Cannon Street, at twelve o'clock noon, precisely.

The Secretary of the West Coast of America Telegraph Company notifies that, in consequence of the difficulties which have lately arisen between the Governments of Chili and Bolivia, the West Coast of America Telegraph Company (whose cables now stretch from Lima to Valparaiso) have been requested to connect the Bolivian port of Autofagasta with their present system, thus placing Bolivia in telegraphic communication with the rest of the world. As this company's telegraph ship is now on the coast, with sufficient cable on board, the connection is expected to be completed within a few days.

The Stock Exchange Committee have allowed 3,000 £10 (fully paid) shares of the India Rubber, Gutta Percha, and Telegraph Company to be added to the 28,200 shares already quoted.

In our last issue we mentioned that there were but two cables working across the Atlantic, and that both were duplexed; this is slightly incorrect, one only of the two being duplexed, viz., that by the Stearns' system.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 57-57¾; Ditto, Preferred, 86-87; Ditto, Deferred, 29-30; Black Sea, Limited, —; Brazilian Submarine, Limited, 6¾-7; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15-15½; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10¼-10¾; Direct United States Cable, Limited, 1877, 11⅛-11⅜; Eastern, Limited, 7¼-7⅜; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 100-103; Eastern, 6 per cent. Preference, 11⅛-11¾; Eastern Extension, Australasian and China Limited, 7¼-7⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 104-107; German Union Telegraph and Trust, 7⅞-8⅛; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 10¼-10½; Great Northern, 8¼-8⅜; Indo-European, Limited, 20½-21½; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 9½-10½; Submarine, 215-225; Submarine Scrip, 1⅞-2⅛; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 8½-9; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 4-4¼; Ditto, 6 per cent. Debentures "A," 92-96, Ditto, ditto, ditto, "B," 87-92; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 100-102; Telegraph Construction and Maintenance, Limited, 31¼-31¾; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2½-2⅝; India Rubber Co., 10½-11.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£ *b*	£	£	£ *b*	£
February, 1879	42,540	12,558	2,800	784	14,180	37,251	22,409	12,087	... ...	8,658	2,400	... ...	4,940
February, 1878 ...	43,470	9,676	2,818	814	10,010	41,831	20,716	12,725	... ...	9,257	1,425	... ...	5,123
Total Inc., 1879	... ...	2,882	... ...	... ...	4,170	... ...	1,693	... ...	... ...	... ...	975	... ...	... ...
Total Dec., 1879	930	... ...	18	30	... ...	4,580	... ...	638	... ...	599	... ...	... ...	183

b Not published.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

Vol. VII.—No. 148.

THE CAPE CABLE.

The decision of the Government with respect to the tenders for a submarine cable communication between England and her South African colonies is said to have been taken; and that of the Eastern Telegraph Company has been accepted.* The three principal tenders were an offer to lay a cable along any route which might be selected, an offer to connect Natal to Cape Comorin in India, via the Seychelles Islands, and, lastly, the Eastern Company's proposal to join Natal to Aden. At first sight it would seem that the second of these, though the most costly, is that to be preferred on Imperial grounds, since it links the South African Colonies to India, which is already connected to England by two routes, the Indo-European line and the Eastern Telegraph Company's cables. But the Indo-European line has the disadvantage of passing through Russian and Turkish territory: and Aden is a point equally connected to India and England. Hence there is, perhaps, little to draw between the Comorin and the Aden routes on the score of policy, while the Aden route is the least expensive to undertake.

The Eastern Telegraph Company have acted in conjunction with the Eastern Extension Telegraph Company, and their tender is said to be a joint one. They undertake to find the capital for the work and to work the cable as a private enterprise, supported by fixed subsidies from the home and colonial governments, making a total of, it is said, £50,000 for a period of twenty years in order to cover the estimated deficit of revenue. In return for this assistance the Company would give a rebate on Government messages. About 4,000 miles of cable will be required to extend the Red Sea Cable from Aden round Cape Guardafui along the east coast of Africa to Port Natal. The depth along the sea board is moderate, so that repairing will, as far as known, be easy. The cable will touch at the chief trading ports, including Zanzibar, Mozambique, Sofala, Delgoa Bay, and end at Durban, where the Cape land line system will be picked up. The cost of constructing the line is estimated at £1,000,000. There are about 2,000 miles of cable ready made, including 1,500 which had been prepared to duplicate the Australian line of the Eastern Extension Telegraph Company from Penang. This portion will be shipped at once to Durban and laid to Zanzibar. This half of the work will be accomplished by the middle of July if all goes well; and the remainder will probably be completed by October next.

The first line of telegraphic communication with the Cape Colonies is thus about to be realised; but the advisability of having an alternative route, though for the present lost sight of, is one which must not be forgot. A west coast cable or an overland line would best fulfil the purposes of such a route. Perhaps by the time the necessity for one becomes imperative, the difficulties of the unknown country between Zanzibar and Gondokoro may be found surmountable, and Mr. Siveright's project find more favour than it does at present. In the meantime, however, a part of that gentleman's scheme might, with advantage, be carried out, and Pretoria connected to Zanzibar by land-line. This plan would furnish an alternative route from Zanzibar to the colonies, which would be an important additional security.

* We hear, as we go to press, that the Government have not yet accepted the Eastern Company's offer, owing to the demand of the latter that the subsidy should be payable whether the cable be working or not.

NEW EXPERIMENTS UPON TELEPHONES WITHOUT DIAPHRAGMS.

By the COUNT DU MONCEL.

M. Ader, the author of an ingenious apparatus known under the name of the Electrophone, has undertaken a series of very interesting researches which not only justify to the full the theoretical ideas which I have put forth for over a year, upon the origin of sounds in ordinary telephones, but have also brought to light effects quite new and valuable to acoustical science.

M. Ader, in fact, has not only succeeded in making a telephone speak without a diaghragm, *but also in making it speak louder and with less change in the voice than ordinary telephones.* We cannot, therefore, now say that the sounds produced by the magnetic core of a telephone are so feeble that they only count for little or nothing in the effects produced, and that in all cases it is impossible to reproduce articulate sounds by them.

From the first, I have held that the reproduction of all sounds in the electro-magnetic telephone ought to be better in proportion as the magnetic organs were less in mass, because the magnetisations and the demagnetisations effect themselves more rapidly as that mass is feebler, lending themselves better to the reproduction of rapid vibrations, and I attributed the greater amplitude of sounds formed by the diaphragm of a Bell telephone as compared with those of the magnetic core, to the smaller mass of the diaphragm. I considered, besides, that the most important *rôle* filled by the diaphragm was to excite the magnetic energy of the core after the manner of an armature. The experiments of M. Ader have fully confirmed my previsions, and whilst a somewhat bulky cylinder

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of iron or a magnetic core, does not reproduce speech under the influence of a current actuated by a speaking microphone, a simple iron wire helix can reproduce it easily, but on condition that one end is fastened to a board (as in fig. 1), and that the other end is free. In these conditions a helix B of a small number of spires can reproduce speech very distinctly, even when the spires are glued with shellac; and with a battery of six Leclanché elements, over a resistance of 10 kilometres (6¼ miles) of telegraph wire, without stopping the reproduction of speech.

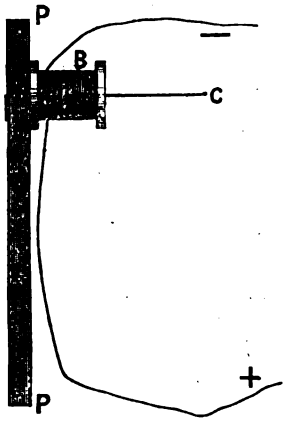

Fig. 1.

But the most curious thing in this experiment is that we can *increase in an enormous ratio the sounds emitted by applying to the free end of the iron wire, and in simple contact with it, a mass of metal.* The sounds are then robbed of their metallic timbre and the voice takes its natural character. In order to hear it, it is not even necessary to apply the ear against the board, for it may be placed at from 10 to 15 centimetres from it without losing the words spoken. What is the cause of this reinforcement of sounds? It is difficult to say, in the actual condition of science, but if we admit that the magnetic core is shortened and lengthened by the momentary attractions among the magnetic molecules at the instant

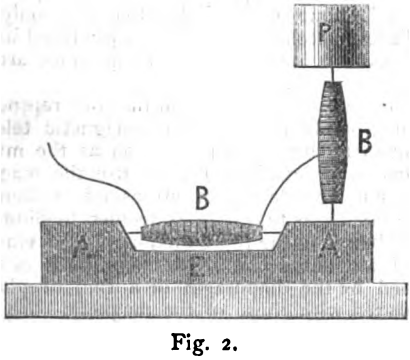

Fig. 2.

of their magnetisation, we may regard it as the result of shocks against a rigid matter incapable of following the molecular movements of the core by reason of the inertia of the metallic mass in contact with the latter. The closer the contact the better is the effect, and because of this, M. Ader solders the metallic mass to the free end of the iron wire. The effect is still more marked when to the two ends of the iron wire we solder metallic masses, but it is necessary that the two masses should not be connected by a substance susceptible of vibrating easily. The following experiment shows that this condition is essential.

If in a somewhat thick metal plate A we cut a notch E sufficiently large (as shown in fig. 2) to allow of the introduction of the magnetic core B, and fix the plate to a board, the core introduced into the notch will give out a confused and weak speech. On the contrary, if we fix the core by one end to the plate, and apply a metallic mass P to the other, the sounds will become very clear and strong. Is there, then, interference of sounds in the first case? It is certain that a magnetic core made of an iron wire stuck by the ends into a board of pine (as in fig. 3), hardly reproduces the sounds, whilst they become very distinct when we fix the iron wire to the board by one end only.

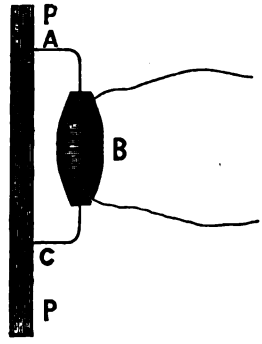

Fig. 3.

M. Ader has also experimented on the sounds produced by bobbins themselves. It has already been proved that bobbins traversed by interrupted currents may produce sounds, as MM. Rossetti, Canestrelli, Saul Roy, Buchin, Hughes, &c., have completely demonstrated; but they have not been able to hear distinct speech in that manner. M. Ader, in studying the phenomena, has been able to make certain that speech may be perfectly transmitted by this means on condition that the spires of the helix are loose and slightly pressed. When they are strongly pressed one against the other or sealed in shellac no sound can be produced; but it suffices to introduce inside the bobbin an iron wire, or needle, in order to render even words audible. M. Ader also finds that the voice can be rendered with a different timbre or pitch according to the degree of tension of the wire, a result due to the fundamental note of the wire blending with the voice. If this fundamental is stifled by pressing the wire between the fingers, the speech is of a dull quality like the voice and always the same whatever the tension of the wire. In fine, M. Ader has proved that we can also obtain speech by passing a curved wire of iron across a fixed bobbin, and in leaning the two ends against the membranes of two tight tambours (as in fig. 4). In these conditions speech can be heard some two or three metres from the apparatus, but

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it is less distinct than in the former plans. The vibrations proceed, without doubt, in this case from the fact that under the influence of wave currents the wire tends to straighten itself more or less, as shown by the experiments of M. Guillemin in 1846.

Lastly, M. Ader has shown that we can also obtain speech from a helix whose spires are buried in shellac, when we place inside that helix another helix in circuit with the first. This effect may be attributed to the same cause, as in the case of the loose spires, to the reaction of the spires of the two helices upon each other.

In applying these different results to the construction of a telephone, M. Ader has succeeded in reproducing speech loud enough to be heard when the instrument is 20 centimetres (about 8 inches) from the ear. The simplest form consists in an iron wire fixed vertically by one end (as in fig 5) to a board of fir-wood A A, and soldered at the other end F^1 to a metallic weight P. On this wire F F^1, is fitted a helix of wire B, which is wound on a quill. When we place the ear behind the board speech is admirably reproduced; the voice is not so false as with the ordinary telephone. It can still be understood when 16 kilometres of telegraph line wire are put in circuit, and with 40 kilometres inserted it can

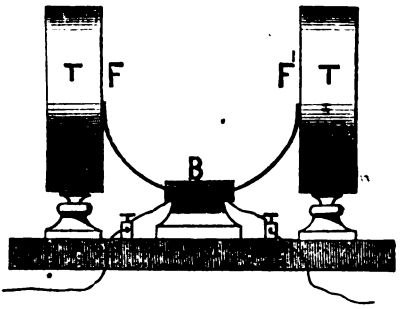

Fig. 4.

still be heard. Singing can be distinguished with 64 kilometres in circuit. Fig. 5 represents the apparatus in its natural dimensions. I will indicate in another article how this telephone can be practicably arranged. To finish with the question just now, I should report some experiments which I made myself relatively to these effects.

We should recollect that Mr. Spottiswoode was the first to publish the fact that speech could be obtained from a telephone without a diaphragm. The truth of this assertion has been doubted by most physicists. Nevertheless, it was confirmed by the experiments of MM. Warwick, Rossetti, Canestrelli, Weisandanger, Lloyd, Millar, &c. But the majority of those who wished to repeat the experiment could only get inarticulate sounds. I have stated the causes of this disagreement and have arrived at the following conclusion.

Generally, an ordinary telephone deprived of its diaphragm does not reproduce speech with the feeble currents of a Bell transmitter, or even with the powerful voltaic currents from a microphone. But if the microphone acts, and sends a current of six Leclanché elements through the primary of an induction coil, the secondary currents induced will reproduce speech, and the reproduction is more marked as the core of the coil is more highly magnetic and of smaller diameter.

By taking a fragment of watch spring, after having well magnetised it, and fixing it (as in fig. 6) by one end on a board, I obtain very distinct speech with a little helix of No. 30 wire, under the influence of a battery of six Leclanché elements acting on the induction coil of a singing condenser; but the helix must be short and placed on the fixed part of the spring. When placed on the free extremity we hear

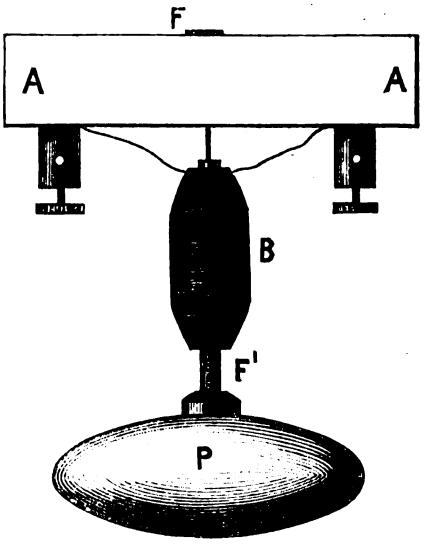

Fig. 5.

no sound, and the reproduction of speech was not obtained when the bobbin was placed in the middle of the plate. This circumstance shows that all arrangements which favour the vibration and free movement of the magnetic core is favourable to the electro-magnetic production of sounds. The insertion of 64 kilometres of line wire in circuit did not forbid speech. Speech could be equally well

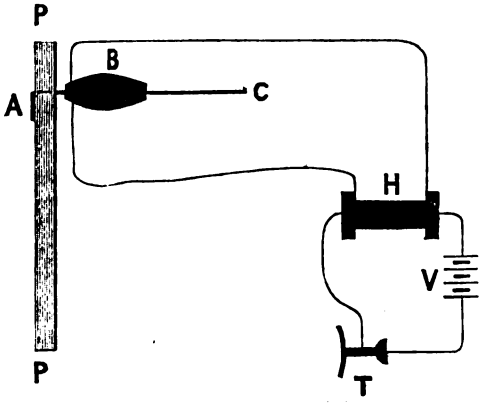

Fig. 6.

transmitted in employing the direct current from the battery; but the interposition of a resistance of 8 kilometres in circuit rendered it so feeble that it could just be heard.

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In these different experiments the microphonic transmitter employed was that which M. Ader had combined with his electrophone, and which is illustrated in fig. 7, but the carbon transmitter of Mr. Edison gave the best results. In that of M. Ader there are two *o* and *c* carbons in contact and one speaks before the cup on the right of the figure. On inclining the apparatus to 45°, the variations of pressure between the two carbons determined by the vibrations of the voice suffice to transmit speech.

All these experiments show that the theories originally put forth upon the telephone are not justified, and that the source of sound in that instrument, which is very complex, ought above all to be referred to the molecular vibrations resulting from the effects of contraction and dilatation produced within magnetic bodies, effects which are reproduced under other conditions in the singing condenser, and the microphone receiver, as I will demonstrate later on.

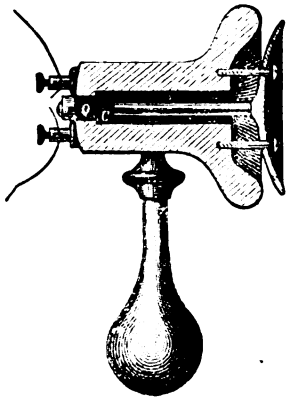

Fig. 7.

The reproduction of speech can also be obtained, but in a far less interesting manner, by vibrations determined by the simple passage of a current wave across a wire of magnetic substance; but, M. Ader has shown *that for this the wire should be soldered at its two ends to two masses of metal, and fastened by means of one of these to a board*, as in the experiment given above. We know that Mr. De la Rive obtained in this way, in 1846, the reproduction of sounds determined by interrupted currents, but he has never obtained the reproduction of speech, and it is owing to the addition of the metallic masses in question that this effect has been obtained. It appears to be impossible, according to the results of M. Ader, for us to attribute it to anything else but the longitudinal molecular vibrations.

M. Ader has tried different metals such as iron, steel, nickel, cobalt, copper, silver, and he has found that only magnetic metals could reproduce this phenomenon. He remarked always that for the success of the experiment it was necessary that the circuit in which the wire was placed should have a very small resistance, and that the battery should be powerful in respect of quantity. A single bichromate of potash element serves the purpose.

In fine, the effects which favour the amplification of sounds in electro-magnetic systems, favour it equally in systems which are simply electro-dynamic, and both depend on the same vibratory cause in relation with the magnetisations and demagnetisations effected inside the sonorous magnetic body.*

EDISON'S NEW TELEPHONE RECEIVER.

THE new telephone receiver of Mr. Edison is, undoubtedly, the greatest step in advance which has been made towards rendering the telephone a loud-speaking instrument. It is no longer the "still small voice" which we have to listen for intently, as the new receiver reproduces the words spoken into the distant transmitter in distinctly audible tones. The sounds, in fact, are as loud and clear as are those received through a short speaking-tube.

The new receiver in principle is based upon the electro-motograph, an invention of Mr. Edison's, which was described in the number of the JOURNAL for Sept. 15th of last year, and is constructed as follows:—

In fig. 1, *d*, *d*, is a mica disc about four inches in diameter, held at its edge by suitable frame work. *c*, *c*, is a cylinder which can be revolved continuously in the direction of the arrows, and which is composed of precipitated chalk mixed with potassium hydrate and mercuric acetate, upon a metallic axle (shown by the shaded lines). This cylinder is kept slightly wetted with water. One end of a metal bar *b* is fixed to the centre of the mica disc, and to the other end is fixed a small platinum point *p*, which presses upon the circumference of the chalk cylinder. The circuit between line and earth is made from this metal bar, through the chalk cylinder. As the cylinder is rotated either by hand or other power, the friction between the metal bar and the chalk cylinder is very considerable, and the diaphragm is drawn or bowed outward toward the cylinder. This operation is purely mechanical and local. When the electric waves are transmitted from the distant station by the speaker (who uses Edison's carbon transmitter connected in circuit with the induction coil A in the usual manner) over the wire to the receiver, each wave as it passes through the chalk cylinder effects by electro-chemical decomposition more or less neutralisation of the friction between the bar and the cylinder, according as the wave may be a strong or weak one. The resultant effect of each wave is the freeing of the diaphragm, permitting it to regain its normal position. Thus a series of electric waves, with the alternate space between, effects a vibration of the diaphragm in perfect accord with the voice of the speaker, the action being solely electrical and chemical. The element of time is not a factor as in the electro-magnetic instrument of Professor Bell, where, as is well known, a perceptible degree of time is requisite for a charge and discharge. In this new telephone apparatus Edison dispenses entirely with the electro-magnet, heretofore used in all telephone receivers, substituting the above electro-

* Count Du Moncel has kindly promised us some further observations on this interesting subject.

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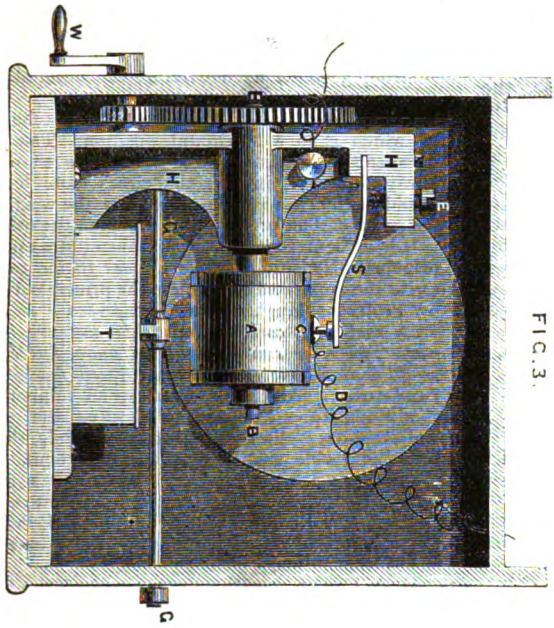

FIG. 3.

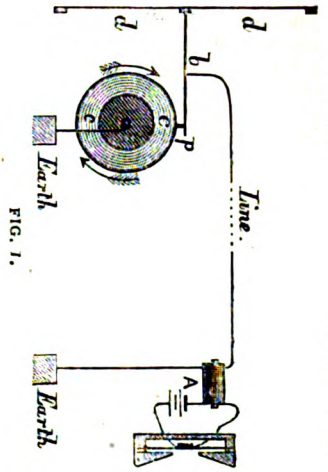

FIG. 1.

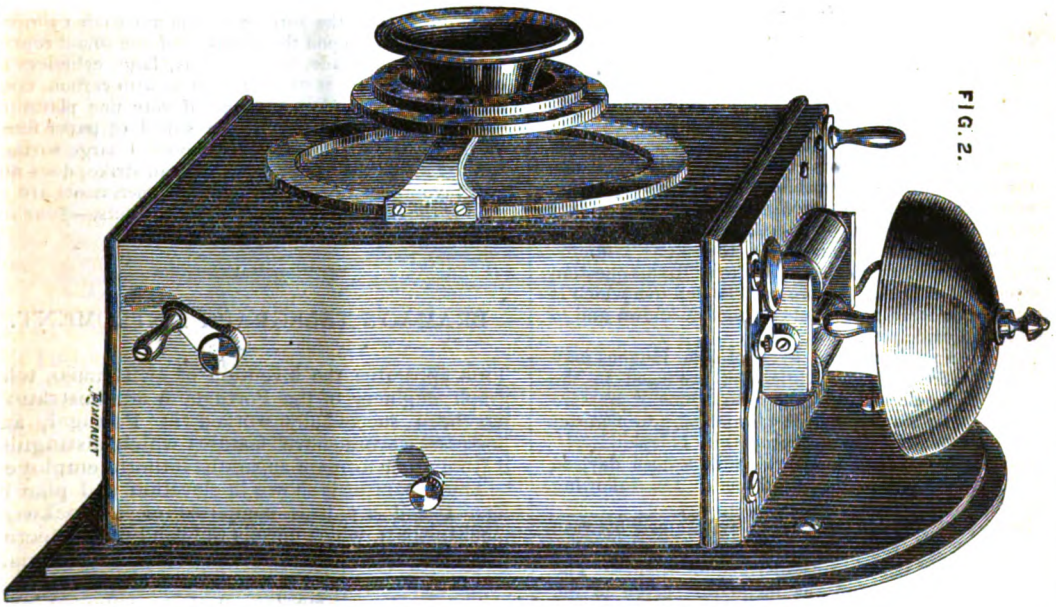

FIG. 2.

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chemical principle. This, by its greater delicacy and power, is made to vibrate a very much larger diaphragm than is possible with the electro-magnet, thus giving greater volume of sound and obviating the necessity for holding the telephone to the ear. By it the voice of the speaker is transmitted to the distant station without the loss of volume. In fact, at times, with a very considerable increase, the telephone speaks louder than the person talking at the transmitting station. It also produces the highest musical notes with the same perfection as the lower ones, something that was found impossible in the old machine. These points of superiority over the electro-magnet are due to the fact that while in the electro-magnet the electric waves constitute the force which vibrates the diaphragm of the receiver, in the new machine they only control it, the force used being strictly local, either the power of hand or clockwork.

Figs. 2 and 3, for which we are indebted to *Engineering*, show the actual construction of the apparatus.

In fig. 3, A is the chalk cylinder, C the end of the lever, with the platinum style; T is a small trough containing water for wetting the chalk cylinder. By turning the axle G a small pad is raised out of the trough and pressed against the cylinder, which thus becomes moistened. The handle, W, is for the purpose of rotating the cylinder.

NOTE ON THE DISTINCTIVE FEATURES OF THE MICROPHONE.

By M. NAVEZ.

WHEN Professor Hughes gave to his first apparatus the name of the "Microphone," the celebrated inventor certainly saw the property which the instrument possessed of reproducing very feeble sounds, amplified. When, however, in order to regulate the action of the instrument, the pressure between the points of contact of the carbons was augmented beyond that due to the weight of the moveable carbon, it is a question whether the principle upon which the instrument worked did not become changed, and whether, therefore, under these new conditions, the name "Microphone" was still applicable. The reply to this question is somewhat difficult. I have tried to find one which is satisfactory according to facts at present known and to established principles.

The principle discovered by Professor Hughes may be thus defined—"The variations produced in the strength of an electric current by variations of pressure at the points of contact of the carbons of a transmitter are proportionally great as the pressure is less."

The different microphones which have been devised can be, almost all, comprised under the following groups:—

Group 1.—A pencil of carbon maintained between two prisms of the same material, in a position approaching that of unstable equilibrium. The sensibility depends upon the inclination given to the carbon pencil. Thus, for example, with a carbon pencil 50 millimetres long and 1 millimetre out of perpendicular, the initial pressure would be reduced to $\frac{1}{100}$th of the weight of the pencil.

Group 2.—One carbon fixed, the other suspended by means of a very fine metallic wire allowing the passage of the electric current. It is this arrangement which I devised, immediately after the publication of the invention of Professor Hughes, with the object of employing it for experiments upon the effects of pressure. The apparatus mounted on a board furnished with levelling screws can be inclined, so as to obtain various degrees of pressure, ranging from simple contact.

Group 3.—One fixed carbon; the other attached to a lever.

Group 4.—Pieces of carbon shut in a tube, the axis of which is in a horizontal position. The pressure between the pieces of carbon is left to chance; it is always, however, in several degrees more feeble than would be the case if it resulted from the weight of the pieces of carbon pressing the one upon the other.

It is evident that all these transmitters take up the principal dispositions which appear to me to characterise the apparatus based upon the principle discovered by Professor Hughes: 1st. *The pressure is exercised from carbon to carbon;* 2nd. *This pressure is always more feeble, or can be rendered more feeble, than it would be if the moveable carbon pressed freely upon the fixed carbon.* All the apparatus which fulfils these two conditions appear to me to deserve the name of "Microphones," because, according to rule, they could transmit feeble sounds and amplify them. As for ordinary speech, up to the present it has not been transmitted without considerable loss of intensity; but microphones are progressing, and I think that it is in this category of apparatus that we must look for the future transmitter.

M. de Capanema, Director-General of the Brazilian Telegraph Administration, writes, that he has obtained better results from microphones with a moveable pencil, by speaking against the board on the opposite side to that on which the microphone is fixed. This observation confirms those facts discovered by Professor Hughes and myself. Professor Hughes has observed that the effect of the microphone increases with the surface of the vertical board; and I have shown by experiment that the surface of the moveable cylinder has no influence upon the intensity of the sound reproduced. I have made, to prove this, large cylinders of elder pith, tipped at the two points with carbon, connection being made by means of very fine platinum wire. I have also shown that a shield of paper fixed on the carbon pencil, so as to expose a large surface against which the sonorous waves can strike, does not give favourable results. All these experiments are of use for the future guidance of experimenters.—*Journal Telegraphique.*

BRAMÄO'S TELEGRAPH INSTRUMENT.

THIS apparatus, the invention of M. Bramäo, telegraph engineer of the Portuguese administration, has been successfully worked in Portugal, and possesses several novel features which distinguish it from other forms of apparatus hitherto employed.

The apparatus is shown in elevation and plan by figs. 1 and 2; it is composed of a clockwork mechanism H, which unrolls the band of an electro-magnetic apparatus E, which reproduces signals, and of a manipulator M which transmits them.

The clockwork mechanism H is composed of a motor, a regulator, and three intermediate gearing wheels. In figs. 1 and 2 it may be seen that the axis or arbor of the second mover passes through the plate *a*, and supports externally the roller *b*, which, aided by the roller b^1, carries the band

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through at an average speed of 50 centimetres per minute. The paper is wound on the wheel R. After leaving this wheel the paper band passes through the opening *c d* formed in the base of the apparatus, rises to the plate *e*, and passes between the rollers *b b*^{1}.

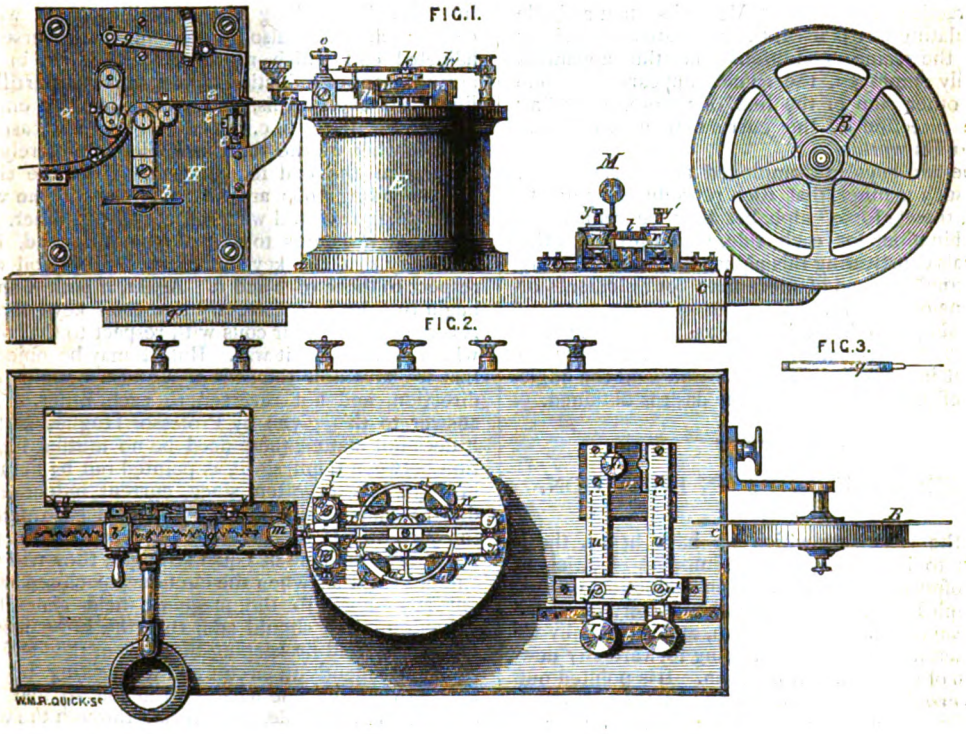
The plate *e* acted upon by the spring *e*^{1} presses the band lightly against the lower surface of the piece *f*, and places it on the receiving plane; the force of the spring *e*^{1} is determined by the screw *e*^{11}. The lever *g* may occupy two positions, one raised and the other lowered; in the latter position it stops the clockwork mechanism and removes the band from the receiving plane simultaneously.

The electro-magnetic apparatus E is composed of an ordinary electro-magnet and a strong magnetic bar bent twice at right angles.

the position of repose of the armature. In case this does not happen this position corresponds to the moment when the extremities *n*^{1} *s*^{1}, *n*^{1} *s*^{1} are arranged identically in relation to the poles *p p*^{1} of the electro-magnet. The screws *l l*^{1}, at equal distances from the appendages *k*, limit each in its own direction the full movement of the armature. The appendage *k* is terminated by a holder or claw which supports the inker *m*, formed of a funnel-shaped cap, in which printing ink is poured. The buttons or knobs *o o*^{1} partly regulate the tension of the contrary springs *j*$^{iv.}$ *j*$^{v.}$.

The manipulator or manipulating piece M, figs. 1 and 2, comprises two flexible springs *r r*^{1}, four contact pieces *t t*^{1}, *u*^{11} *u*^{111}, a commutator V furnished with two springs *u u*^{1}, and a pin or peg v^{1}.

The ends of the springs *u u*^{1} of the commutator



The poles *n s* of the magnet and the poles *p p*^{1} of the electro-magnet are in the same plane, and are respectively placed at the extremities of two perpendicular diameters. These poles, divided in two in the direction of the circumference, freely contain the armature *n*^{1} *n*^{1}, *s*^{1} *s*^{1} composed of two semicircles of soft iron *n*^{1} *n*^{1}, *s*^{1} *s*^{1}; these two semicircles are united by a copper cross I to an axis or arbor 2 in the centre of the apparatus.

The levers *j j*^{1}, figs. 1 and 2, are moveable in their axis *j j*^{111}, and by yielding to the action of springs *j*$^{iv.}$ *j*$^{v.}$ acting in contrary directions transmit, each on its own side, the action of these springs to the appendage *k* of the armature; this action is limited on both sides by the piece *k*^{1}, which by its lateral play, enables it to cause the direction which the levers *j j*^{1} give to the appendage *k* to coincide with

press against two insulated pieces which are fixed on the under surfaces of the blades *r r*^{1}.

The two blades are ordinarily in contact with the screws *x x*^{1} of the piece *t*, and are consequently removed from the contacts of the piece *t*^{1}; the same separation also exists between the extremities of the springs *u u*^{1} and the contacts of the pieces *u*^{11} *u*^{111}.

When the spring *r* is pressed down the contacts of *r* with *t*^{1} and of *u* with *u*^{11} are simultaneously established; when the blade *r*^{1} is lowered the contacts of *r*^{1} with *t*^{1} and of *u*^{1} with *u*^{111} are established in the same manner.

The screws *x x*^{1}, in constituting the contacts o the piece *t* also serve to regulate the full movements of the springs *r r*^{1}. The pin or peg v serves to put the commutator V into metalli

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connection with the springs r or with the spring r^1, according to the side on which it is placed.

Fig. 3 is a small pricker for clearing out the orifice in the ink cup should it become clogged from disuse.

The following is the action of the apparatus :— By supposing the regulator of the clockwork mechanism and the plate e free from the action of the lever g, which occurs when the latter is raised, the band unrolls uniformly in the receiving plane, and receives a continuous line or stroke from the very fine orifice of the inker m.

According to the movements of the armature, and consequently the displacements of the inker, this stroke or line is converted through the influence of the currents into angles to the right and bars or lines to the left; the signals produced in fact are very similar to those obtained by means of Thomson's Siphon Recorder.

In practice, if as in the "Morse' system a single manipulating key is used, the apparatus is precisely under the same conditions as the apparatus generally employed, the signals appearing on one or the other side of the line of repose, according to the direction of the current with which the apparatus is worked.

If the two keys are employed at the same time, but in such manner that each reproduces complete signals, the "Morse" alphabet may be reduced to 30 combinations for each side, which produces the 60 signals constituting this alphabet, without having to use combinations of more than four elements or emissions of current.

By using two keys, but so as to produce only elements of short emissions of current, the angle to the right in substitution of the dot, and the angle to the left in substitution of the dash is obtained.

PROFESSOR HUGHES ON INDUCTION.

FROM the criticisms which we have heard, there appears to be an impression amongst electricians that Professor Hughes' paper on Induction on Air Telegraph Lines, read before the Society of Telegraph Engineers on March 12th, and treated by us in our last number, does not bring forward any new solution of the induction problem. It is pointed out that reversed induction coils inserted at the beginning of two lines have been employed by Mr. Wilson of Chicago, and Mr. Little of New York, as well as by other electricians. But there is an important essential difference between these earlier methods and that of Professor Hughes, which a fuller study of his paper than we had time to give it before our last issue, has made clear to us. Professor Hughes' researches were of that kind which are not grasped at once from merely hearing them read over; and it is matter for regret that a special night was not set apart by the Society for the full discussion of them after members had had time to study the printed paper thoroughly. As it is, we fear that many of those present at the meeting did not understand the results submitted to them, and not understanding them, did not, of course, appreciate them. Hence it has come to pass that one of the most important and original contributions of the winter has been hurried over in neglect.

The plan of connecting reversed coils in circuit with the wires of the line, and adjusting their mutual induction so as to balance the mutual induction of the wires, as used by Mr. Wilson, is sufficient for a two wire line; but when three or more wires have to be balanced it fails. To apply it to ten wires, for example, as many as forty-five coils would be required and even then the balance would be imperfect. This is due to the necessity of making the balance so that any number of the ten wires may, in actual working, become primaries to the others as secondaries; in short, that all sorts of combinations of the inductive influence may take place.

Now, Professor Hughes dispenses with the need of so many coils, 1, by making the length of each coil proportionate to the length (and resistance) of the actual wire it stands for, and its distance from each of the other coils proportionate to the distance of that wire from each of the other wires of the line; 2, by making the signalling key which closes each circuit, also by the same act, reverse the adjusted coil which represents that wire in the arrangement of induction coils forming the artificial line. To explain this, let us consider one end of the three wires A, B, C, in order. The first case we have is when all the three are silent or merely receiving at the end in question. Here the three corresponding coils are all in circuit in one way, some being reversed with respect to the other. If, however, A begins to signal from one end, it is necessary that the key should reverse A's coil with respect to those of B and C. Again, if both A and B begin to work it is necessary that their keys should reverse both of their coils with respect to that of C, which remains as it was. But, it may be objected that we have now the coils of A and B both in one direction, and not reversed to each other. The answer to this, given by Professor Hughes, is, that it does not matter, there need be no mutual induction between them, since, as pointed out by Faraday in 1832, but forgotten since, current induction is due to changes in the magnetic field surrounding the current. If, then, the simultaneous currents of A and B were made of equal strength, they will rise and fall together when the circuits are closed without any shock to the magnetic field generating induction. We should add, that the same results may be secured by keeping the coils of the artificial line permanently in circuit and connecting up the key between the line wire and the coil, so that the current should divide, part flowing through the wire to the distant station and part flowing in the reverse direction through the coil to earth.

A NEW KIND OF TELEGRAPH CABLE.

A COMPANY has recently been formed at Cortaillod, in Switzerland, for the purpose of manufacturing a new kind of telegraph cable, the conductor of which is formed of lead and the insulating material of a resinous or sulphurous substance, the whole being covered by a lead tube.

In spite of the slight flexibility of the insulating substance the new form of cable is very pliant, being by no means inferior in this respect to other forms; also the conductor rigorously preserves its

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central position in spite of any bends which may be made in the cable.

In a recent number of the *Journal Télégraphique*, M. Rothen has given the results of some tests he has made of this form of cable.

Three specimens of this cable were experimented upon, the two first only differing from one another in their respective diameters, the insulating material being of a resinous nature. The third cable had an insulating dielectric of a sulphurous nature.

The lengths, weights, &c., of the cables were as follows :—

	No. 1 cable.	No. 2 cable.	No. 3 cable.
	Metres.	Metres.	Metres.
Length	90	110	100
	Millimetres.	Millimetres.	Millimetres.
Diameter of conductor	1·43	1·7	1·7
Exterior diameter of dielectric	2·9	3·7	3·9
Exterior diameter of protecting lead tube	4·8	5·9	6·3
	Kilo-grammes.	Kilo-grammes.	Kilo-grammes.
Weight of 100 metres of cable	13·8	20·5	20·9

The cables before being tested were immersed in water for 5 days.

As a standard of comparison a gutta-percha covered copper wire 100 metres long was taken, the diameter of the conductor being 1·4 millimetres and the diameter of the dielectric 4·3 millimetres.

The tests were made with a battery of 150 Daniell cells.

The first tests made were for inductive capacity, the results being as follows :—

	No. 1 cable.	No. 2 cable.	No. 3 cable.
Capacity in microfarads per 100 metres ...	·0184	·0162	·0232

The capacity of the gutta-percha wire per 100 metres was ·0237 microfarads.

The insulation resistances of the cables measured by the ordinary deflection method were as follows:—

	No. 1 cable. Megs	No. 2 cable. Megs.	No. 3 cable. Megs.
Insulation resistance in Siemens' units per 100 meters ...	133,164	162,756	143,028

The resistance of a similar length of the gutta-percha wire was 93,708 megs., the temperature of the tank in which the cables were immersed being 19° C.

The conductor tests gave the following results :—

	No. 1 cable.	No. 2 cable.	No. 3 cable.
Resistance of conductor in Siemens' units per 100 metres.	12·17	7·49	8·21
Temperatures	10·5° C.	9·5° C.	9·5° C.

The resistance of the copper conductor of the gutta-percha covered wire per 100 metres at 19·5° C. was found to be ·97.

If we compare these results by allowing for the varying diameters of the cables we get the following :—

	Insulation resistance.	Inductive capacity.	Conductivity.
Gutta-percha cable with upper conductor.	1·000	1·000	10·000
No. 1 cable	1·987	·558	·998
No. 2 „	2·208	·540	1·147
No. 3 „	1·817	·826	1·047

These results show that the three cables have an average specific insulation resistance of about double that of gutta-percha, whilst the specific inductive capacity of cables 1 and 2 is rather more than one-half that of gutta-percha. The conductivity of the conductor is extremely low, being only about $\frac{1}{10}$th that of copper.

FULLER'S ELECTRIC LIGHT.

A THIRD lamp for household use has been invented within the last year and nearly perfected. One of the early friends and associates of Edison was a young man, named J. B. Fuller, a Connecticut Yankee, in whom the inventive faculty was active from boyhood. Fuller made a great deal of telegraph machinery and invented many industrial processes, such as modes of utilising wood pulp in paper-making, &c. Ten or fifteen years ago Fuller separated from Edison because it would no longer do to have them work in company. The inventions of the one might easily have been said to be due to the suggestions of the other, and so the two men parted, never to see each other again. They were men of very different qualities, Edison being quick to seize upon a new thought in natural science and apply it to practical use long before any one else could see its practical value, while Fuller loved deep problems and research, and was much more gifted in the work of discovering new principles than in applying them. He was an eager student and a desperate worker, and he succeeded in mastering so many of the mathematical and other problems connected with electrical science that he became the greatest authority thereon, particularly on magnetic induction, in this country. Fuller took up the subject of the electric light in 1874, and has been studying it, in an obscure laboratory in Brooklyn, until the present year. He found at the outset, like so many other men, that there was need of a good magneto-electric machine. He invented his own, based on the principle of Gramme's, and produced so powerful a one, that three years ago he succeeded in having it adopted by the Stock and Gold Telegraph Company of this city for practical telegraphy. The company named has over a thousand machines in different parts of the city, upon which are printed every few minutes the quotations of stocks in Wall Street through the business hours of the day. The Fuller magneto-electric machine was adopted to operate the wire connecting with these stock and gold indicators. Fuller has studied ever since to improve his generator; but when he had once obtained a generator of reasonable power, he returned to experiments with a lamp. He shunned publicity, and in the obscurity of his little shop he toiled for years over his lamp. He was the man best fitted in the United States to attempt a solution of the problem. This inventor evolved a whole system of lighting—the generator, a lamp, and a meter. He proposed to use two large street mains, one of them insulated, disconnected at the outward ends. The positive main was to throw off a branch wire into each building to be

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lighted, the wire entering the meter, performing a certain service there, and then returning to the street to the negative main. The main current was not to do the lighting, but it was to generate another current in a series of induction coils, and each lamp was to be lighted by the current from one of these coils. An alternating current was to be used. The induction coils were thus made:—Two magnet cores, arranged parallel to each other, were connected magnetically at the ends. Around the centres of each of these cores was a soft iron head, and at a proper distance from this a head of insulating material. The outward ends of the cores were coiled with insulated copper wire, and so connected together and to the main wire (or generator) as to produce two opposite magnetic poles. Between the soft iron heads and the coils were wound smaller coils of insulated wire, the fineness of which would depend on the tension required. To one of the iron heads was hinged an iron arm, so made as to swing over upon the other, connecting magnetically the poles N. and S. In a coil so made, if a current be sent through the main wire rapidly changing in opposite directions, the magnetic cores will change polarity and the change will induce a current of great tension in the smaller coils, and this second current, if conducted by proper wires to a lamp, will maintain platinum or carbon in a high state of incandescence. Two induction coils, or four, can be coupled together for lights of stronger power. A graduated switch is used in this lamp, so as to permit its brightness to be varied at will. A great many experiments were made with this style of lamp with platinum burners, and they operated admirably. A number of capitalists of Brooklyn, hearing about these experiments, organised a company with 1,000,000 dollars capital last December to adopt Fuller's inventions and introduce his light throughout Brooklyn. A new shop was fitted up for the inventor on Broadway, near 36th Street, in New York City, near his residence, and in this shop Fuller toiled for six months almost literally day and night. His whole system was in a most promising shape, when last February an incident occurred which put a stop to the progress of experiments in household lighting.

The company had determined to manufacture point-to-point lamps and magneto-electric machines first for factory use. About twenty factories in New England and the Eastern states have this winter introduced the large electric lamps of from 700 to 2,000 candle-power into their work-rooms, and the demand for the means of lighting had suddenly become very active. The Fuller Company resolved, therefore, to solicit orders from factories, and it had 75 machines constructed, which are being finished up this week for factory use. During the first week of February Mr. Fuller was engaged in perfecting a new point-to-point lamp and began to be troubled with insomnia. Against the advice of his friends, he worked on his new lamp until it was finished. In the act of tightening up the last screw he fainted and fell to the floor of his shop entirely exhausted, completely worn out with intense mental application and lack of sleep. He was carried to his residence. A week afterwards he had recovered so as to be active again. His busy mind had, in the meantime, discovered a new idea in induction. He sent over to the shop for his man George, the foreman of the works, to explain to him the new idea. The two men sat down together, and Mr. Fuller described his idea with much minuteness—the shape of the magnets, the size of the wire, the manner in which the wire was to be coiled on, and so on, motioning with his hands to illustrate his meaning. When Mr. Fuller had finished, he said, "George, do you understand that?" His foreman replied that he did. "Now," said Mr. Fuller, "I want you to understand that, George, for it is very important;" and then he went over the matter again, explaining the whole idea, with the mathematical principles involved in it. When he had completed the explanation the second time, he said, "Now, George, do you think you understand that?" The foreman said he did perfectly. Mr. Fuller looked pleased, lay back in his chair, and died soon afterwards. This was on the 15th of February. The inventor's life had flickered out, quietly, but unexpectedly to both men, and Mr. Fuller, as every one who is acquainted with his plans believes, has departed just at the moment when he was about to become famous and rich. His foreman was of too practical a turn of mind to see the poetic aspect of such an incident, and it is only within a day or two that the facts have been privately obtained by the writer.—*The Times*, Mar. 22.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

A NEW DUPLEX SYSTEM.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—With reference to your footnote to my letter, in your edition for March 15th, 1878, respecting the "Moveable Coil," this appeared to me to be a necessity, rather than a "feature," for purposes of adjustment, balancing, &c. (The system depending more upon the method of *dividing the coils*.)

I purposed making one of the coils into a kind of rheostat to effect this object, but as I received no encouragement to proceed with the experiment, I concluded that the "differential system" was preferred.

I need not comment upon Mr. Banker's battery or other arrangements.

E. A. TURNER.

Liverpool, *March* 21, 1878.

F.—We are unable to say whether the key you refer to is similar to your own, as the patent specification contains no further particulars than those given in our extract.

SCHUCKERT'S DYNAMO-ELECTRIC MACHINE.

THE improvement, introduced by Mr. S. Schuckert, consists in the construction of dynamo-electric machines with the most advantageous arrangement for utilising the induction wire or conductor on the revolving iron armature so as to reduce the warming of it to a minimum.

For this purpose the armature is made flat, and composed of several sheet-iron discs. Both side faces as well as the outside are brought under the influence of the magnetic poles, and these poles are arranged with their highest intensity of magnetism directly opposite the side faces of the ring.

The flat ring is made out of a number of sheet-iron discs, which are magnetically insulated from each other, which serve to save power and prevent over warming of the ring during working; because in these single sheet-iron rings of small volume, the pole changing goes on with little resistance, and the residual magnetism is easily destroyed. The warming

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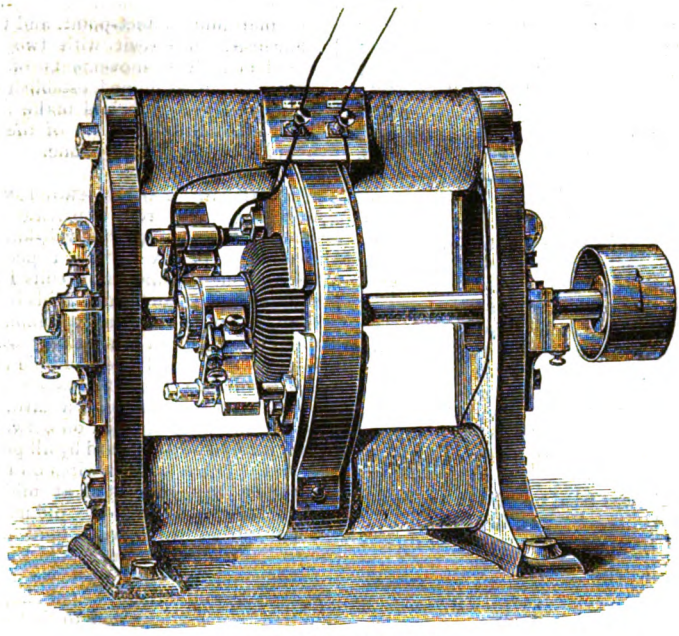
is also prevented by the constant contact of a large portion of the ring with the outside air.

The electro-magnets face the ring with their curved pole plates, forming the two north and south poles, and cover over two-thirds of the whole surface, making opposite polarity in the ring, which becomes

The induced currrents in one half of the ring are in one direction, and those in the other half in the other.

The generated currents on the upper part of the ring, above the neutral line are opposite to those generated below that line, and would neutralise each



SCHUCKERT'S MACHINE.

a south pole before the north pole, and a north in front of the south. They form magnetic fields of high intensity through which the copper wire, or any other good conductor wound about the iron ring is moved during the action of the machine, whereby electricity is induced in the said conductor.

other. To prevent this and utilise them, they are collected near the neutral points by metallic brushes, touching the axle, on which there are a number of insulated metallic pieces, each one connected with a conducting wire coming from the revolving armature.

Notes.

THE ELECTRIC LIGHT.—Colonel Haywood, the Engineer to the City Commissioners of Sewers, has reported on the recent experiment in lighting the Holborn Viaduct by electricity. He states that the total cost of the experiment up to the 18th of February (64 nights) was £785. The sixteen electric lamps were lighted from sunset to midnight at a charge of £5 per night, averaging seven hours. The cost per lamp per hour was over 10d. A gas lamp on the Viaduct, including lighting, extinguishing, and cleaning, cost £4 17s. 6d. per annum. It was alight 4,300 hours annually, and the cost of each lamp per hour was but little over one farthing. The cost, therefore, of lighting the whole Viaduct during the winter months by electricity would be 14s. 3½d. per hour, and by gas 1s. 11¼d. per hour, or by night of fourteen hours' duration, £10 by electricity and £1 7s. 1½d. by gas. Applying these rates to a whole year, electric lighting would cost about £3,072 and gas lighting £419. Electric lighting at these charges was, therefore, about 7½ times as dear as gas lighting. As to illuminating power, Colonel Haywood estimates approximately that it is about seven times that of gas.

LIGHT BY INCANDESCENCE.—In our Spanish contemporary, the *Cronica Cientifica*, M. Alf. Niaudet expresses a very decided conviction that carbon, and not platinum or any other metal, is the best material for the production of the electric light by means of incandescence. In support of this position, M. Niaudet adduces the following arguments: 1. At equal temperatures, carbon possesses a power of radiation in excess of that of platinum. 2. The heat capacity of platinum is far greater than that of carbon, and the former, consequently, requires a far greater amount of heat than the latter to bring it to a given temperature. 3. Carbon is a worse conductor of electricity than platinum, and, consequently, may be of greater diameter without the temperature being reduced. 4. Carbon is absolutely infusible, and may be brought to a white heat without the circuit being interrupted owing to fusion.

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TEMPERING THE ELECTRIC LIGHT.—It has occurred to a Frenchman that as clouds temper the brightness of the sun, so an imitation of clouds, by wadding made of glass fibre, would temper the electric light; and by using screens of glass wadding instead of opaline or clouded shades he reduces the loss of light from 50 to 25 per cent.

WE have received Mr. Killingworth Hedges' pamphlet entitled "Useful Information on Practical Electric Lighting." (E. and F. Spon, publishers.) It is designed as a guide to the unscientific public, who wish to make use of the new illuminator, and is the best of its kind we have seen.

MR. EDISON has exhibited the working of his incandescent light in the illumination of his laboratory and factory with excellent results, furnishing 14 of the new lamps, each from 18 to 20 candle power, on one circuit, giving a steady white light, much superior to the carbon, and equal to double the number of gas jets. The generator was an ordinary Gramme machine of 2½-horse power. Mr. Edison states that he can now supply light for practical domestic use at less than half the cost of gas, but is experimenting for further improvements in the lamp and economy in the generator. —*Daily News*, March 28.

THE Metropolitan Board of Works have decided to continue the Jablochkoff lights for three months longer on the Thames Embankment, at a reduced cost.

JABLOCHKOFF'S candle was tried on March 13, in the theatre of the Royal United Service Institution, as a means of illumination for facilitating surgical operations and examinations in dull weather or after dark. Mr. Balmonno Squire, Senior Surgeon to the British Hospital for Diseases of the Skin, exhibited a remarkably small, light, and portable hand-lantern, containing in a tube projecting from the back of it (which tube served also as a handle for the lantern) a Jablochkoff candle. By means of a screw contrivance fitted in the tube the burning end of the electric candle could be advanced forward into the lantern as the candle gradually burnt back. This, with two connecting screws for attaching the electric wires, formed the whole of the apparatus. A minute window formed of dark-blue glass placed at the side of the lantern formed the means of ascertaining from time to time the exact position of the burning end of the electric candle. He advocated its use as a means of affording a powerful and steady light in the dark cock-pit of ships of war. He also advocated the use of his electric lantern for similar reasons in military field-hospitals, where the same conditions present themselves during a night encounter, and pointed out that, while for military purposes the necessary electric and steam engine conveyed on the same carriage would be far lighter than an ordinary piece of field artillery, yet for naval purposes the requisite steam power was always on board, and on most war-ships the necessary dynamo-electrical machine was already in use for electrical illumination against torpedo practice. The force required to generate the light he placed at only one and a half horse-power, and the cost of the apparatus £100.

THE TELEPHONE.—Mr. Elisha Gray's patent for telephones granted on July 27, 1875, has been extended by the U.S. Patent Office. This patent is worked by the American Speaking Telephone Company, and, as is well known, the owners maintain that it covers the Bell telephone, a claim which, we apprehend, no unprejudiced expert will allow.

THE SPHYGMOPHONE is the name given to a patented contrivance for rendering the beating of the pulse or the heart audible to a roomful of people by its inventor, Dr. S. Th. Stein, of Frankfort. The apparatus consists of a piece of watch spring, five centimetres long, which is soldered to a small brass frame, and is provided at its free end with a gutta percha knob. This small knob is placed against that part of the human body whose movements are to be made audible. The knob carries a platinum contact-plate, opposite which is a platinum contact-point, and these two contacts are connected in circuit with two Bunsen cells and a telephone. The movements of the pulse, or other organ to be examined establish contact between the point and the plate and make and break the circuit. Hence the natural rhythm of the pulse or the heart is heard aloud in the telephone.

FEATS OF THE MICROPHONE.—We extract the following items from a private letter written by Mr. Louis J. Crossley, of the well-known firm of Crossley Brothers, Halifax:—"By a peculiar arrangement of microphone and induction coils I exhibited in a large room at our Dean Clough Mills Institute, to an audience of over 500 persons, an experiment in which the music of a cornet as well as speaking was transmitted a distance of a mile and made audible to the entire audience.

I have also tried the same arrangement between Halifax and Manchester, a distance of 34 miles, and conversation was carried on between the two places so that it could be well heard by all present in the respective offices. There were 22 wires on the poles and the experiment was conducted at midday, when the wires were busiest, so that the induction sounds from the neighbouring wires were loud enough to be clearly heard at a short distance from the receiving telephone.

For some months past we have got every word spoken from the pulpit of our chapel on Sundays transmitted to my house, and to that of an invalid lady residing close to me, a total distance of about three miles.

MR. LATIMER CLARK has issued an address to the President and Council of the Society of Telegraph Engineers, suggesting wider scope for the Society.

MR. SCUDAMORE has gone to Beyrouth at the request of Midhat Pasha.

AN ELECTRIC BORER.—M. Gaston Planté has published his important researches on electricity and the electric discharge in an octavo volume dedicated to the Emperor of Brazil. From a copy of these very interesting studies now before us, we extract the following passage relative to the boring power of the electric spark:—"We have seen that one of the electrodes which conveys a current of a certain electromotive force on being put in contact with glass, in presence of a saline solution, acts as a graver or a diamond in cutting furrows on the surface of the glass, ploughing it even deeply. Rock-crystal can also be attacked, despite its hardness, by the same method, and if it does not yield regularly it at least bursts into pieces under the influence of the electrode, and ends by breaking up. In America black diamonds are employed in rock drilling for wells and mines. Could these expensive tools not be replaced by the action of the electric current in conditions analogous to those which have been described, and the perforation of rocks be performed by electricity? Electrodes of platinum would not be necessary, for it is not the metal of the electrode which alters, but merely the silicious matter in presence of the saline solution. Metallic points or studs conveniently distributed at the end of the drill and put in rotation would direct the electric discharge to the rock, which it would pulverise as in the case of the diamond drill. The recent advances

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in the production of electricity by mechanical means would facilitate this application."

THE VOLTAIC PENCIL.—Bellet's voltaic pencil, which has been patented in England in the names of Louis Bellet and Count Hallez D'Arros, founder of *L'Electricite*, was exhibited, along with some of its work, at the Scientific Soirée given by Admiral Monchez, at Paris, on Feb. 21. These works comprised engravings on copper, steel, and stone, executed at first hand by the spark from the pencil point, and electro-stencils or copies of documents and drawings. It is believed that this electric graver and pencil will be useful in military topography.

While in Paris General Grant had his portrait taken by the light of Jablochkoff's electric candle. This is a case in which the artist could not happily apply the proverb, "Le jeu n'en vaut pas la chandelle."

MESSRS. CROSBY LOCKWOOD & Co. are about to issue a revised edition of Dr. Noad's work on Electricity, with an introduction and additional chapters by Mr. W. H. Preece.

CLERAC'S TUBE.—Professor Barrett has kindly sent us a copy of his lecture on Mr. Edison and his Work, which is now published as one of the science lectures for the people, and a very interesting one it will form. It is right that one who addresses the people on matters of science should render scrupulous justice to the merits of discoverers and inventors, for the subject is one on which the people cannot judge for themselves, and must implicitly trust their teachers. We are therefore gratified to find that Clerac's tube is referred to by Prof. Barrett in the printed pamphlet as follows:—"It has been said that a French electrician, M. Clerac, discovered this property, and made an instrument such as I have described, some twelve years ago. In fact Prof. Hughes, whose name is well known in connection with his invention of the printing telegraph and the discovery of the microphone, writes to me that since 1866 he has had in his possession a resistance tube made by Clerac, in which plumbago, more or less compressed by a screw, was employed, and the resistance made to vary by pressure. This tube has been seen by many. It is known that Clerac used squeezed plumbago as a stated resistance, but I can find no *record* of its being used as a *variable* resistance. Nevertheless, eminent eye-witnesses declare such was the case, and I do not doubt their statement, though this does not amount to publication in the scientific sense. Edison certainly independently re-discovered and greatly increased the importance of the effect of pressure on carbon dust. The only person who previously to Edison seems to have noticed that pressure made any difference in conductivity was a well-known electrician, the Count du Moncel, who, twenty years ago, pointed out this fact as a curious property most marked in semi-conductors. This incidental observation was, I believe, forgotten till, in 1873, Edison re-discovered and greatly extended it. I refer to this particularly, as considerable discussion and much misunderstanding has arisen therefrom, a misunderstanding which led Edison to use hasty expressions which, though deplorable, were natural enough to a man who considered himself grievously wronged; but the ground of offence would never have occurred had a better understanding existed on both sides."

SPEED OF A SIGNAL.—Recent experiments prove that a signal sent over the land-line from Paris to Marseilles, a distance of 525 miles, takes 0·024 sec. to travel, whereas a signal sent through the Marseilles-Algiers cable, a length of 574 miles, takes 0·233 sec.

BLASTING POST HOLES.—According to the *Scientific American*, telegraph post holes are blasted out in Pennsylvania by a man driving a crow bar four or five feet into the ground, then dropping in a cartridge and a lighted fuse. Before he reaches the site of the next pole the cartridge explodes, making a pit as large as a flour barrel. In this way four men will set up 100 to 150 poles a day.

GARY'S MAGNETIC MOTOR.—A rival to the Hosmer motor has appeared in America. It is said to be based on the discovery of a neutral line in the magnetic field of a horse-shoe magnet in front and on either side of the holes. A piece of soft iron in this neutral position appears to have no polarity, but the slightest change of position to one or other side of this line produces positive or negative polarity in it. Mr. Gary, we believe, claims to get unlimited power without expenditure of fuel by taking advantage of this property of the field. If so we fear that Mr. Gary will experience a disappointment.

FIELD TELEGRAPHS.—Lord Chelmsford has asked for a field telegraph to be sent out to him; also electric lights for his encampments. The Ordnance Department at Woolwich have accordingly forwarded a fully equipped wire-waggon-and-barrow apparatus to the *Loanda*, now taking in cargo at the Royal Arsenal. The waggon consists of a strong but simple framework on ordinary wheels, supporting on revolving spindles six drums or reels of telegraphic wire, the movement of a lever and clutch causing the vehicle either to lay or pick up the wire as it passes over the ground. The barrow carries a single drum, and is mounted on wheels only 2 ft. high, with a 2 ft. track. It resembles an ordinary hose-reel, and is so light that it can be run over the field by one or two men, and can, therefore be of use during an action. Each drum carries 133 lbs. of wire. The waggon carries telegraph poles, a ladder and tools for constructing an "air line." The poles consist of iron tubes, in lengths of about ten feet, uniting by a bayonet joint and secured by three guy lines. A few sets of electric lighting apparatus and portable engines will also be sent out. The force under his command does not seem even to have been provided with Mance heliographs.

A CABLE JUBILEE.—We learn from the *Scientific American* that Mr. Cyrus W. Field gave a grand dinner party on March 10, in celebration of the twenty-fifth anniversary of the formation of the Company of New York Merchants which helped to lay the first Atlantic cable. Of these gentlemen only one has since died, namely, Mr. Chandler White.

AT the International Meteorological Congress which will meet in Rome on April 14, the project of establishing an Arctic observatory at Wilzeck, in Nova Zembla, will be discussed. Electric and magnetic observations form an important part of the scheme of work which has been devised by Messrs. Weyprecht and Payer.

A MEETING is to be held in New York on April 30 to arrange for an International Exhibition at New York, in 1889, the centennial of the anniversary of the Union of the States. Dr. Norvin Green, President of the Western Union Telegraph Company, is one of the Executive Committee. This is taking time by the forelock, but the occasion is a great one, and the Exhibition will be so also, provided the world doesn't come to an end meanwhile, and the United States be disunited into infinite azure.

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IN the United States Senate, on Monday, Feb. 24, Mr. Hamlin, from the Committee on Foreign Relations, reported adversely on the Senate bill to grant to the American Ocean Cable and Telegraph Land Wire Association of Philadelphia the right of way and privilege to lay, land, and operate submarine cables on the Atlantic and Pacific coasts of the United States, and establish telegraphic communication between the United States, Europe, and Asia, and it was indefinitely postponed.—*Journal of the Telegraph*, U.S.

Two men were executed at Mauch Chunk, Pa., on Jan. 14, and immediately after the drop had fallen a telegraphic reprieve arrived from the Governor, but was just about half a minute too late.—*The Operator*, U.S.

New Patents—1879.

876. "Mode of and apparatus for producing light by electricity." J. B. SPENCE. Dated March 5.

925. "Electric lamps." K. W. HEDGES. Dated March 8.

926. "Improvements in electro-dynamic and dynamo-electric apparatus, and in the application thereof to effect discontinuous movements in parts of engines and machinery." M. P. W. BOULTON. Dated March 8.

927. "Means employed for producing the electric light." R. C. THOMPSON. Dated March 8.

935. "Improvements in galvanic batteries and in the application thereof to luminous buoys and for other purposes." L. A. BRASSEUR and A. E. DEJAER. Dated March 10.

947. "Apparatus for electric lighting." H. J. HADDAN (communicated by C. F. Brush). Dated March 11.

960. "Dynamo-electric machines." L. SIMON (communicated by S. Schuckert). Dated March 11.

1012. "Mode of obtaining electric lighting." A. L. COKE. Dated March 14.

1015. "Electric batteries applicable to telegraphic and other purposes." T. J. HOWELL. Dated March 14.

1122. "Improvements in the means or apparatus for obtaining light by electricity and in the manufacture of materials to be employed therein. H. G. L. FOX. Dated March 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

2640. "Magnets for separating metallic substances from materials used in the manufacture of pottery." E. LAKE and J. EDWARDS. Dated July 2. 6d. To render magnets incorrodible, so as not to contaminate the materials of the ware, they are covered with enamel or electrotype. The magnets are plate-shaped, and pierced with holes to expose much surface to the glaze or other materials to be cleaned.

2878. "Electric motor." E. J. HARLING. Dated July 18. 4d. A shaft, carrying pairs of radial arms shod with iron armatures at their ends, at different angles to each other, is caused to rotate by the attraction of properly exerted electro-magnets on the iron armatures. (Void by reason of the patentee having neglected to file a specification, in pursuance of the conditions of the Letters Patent.)

3011. "Rheophores, commutators, and galvanic batteries." JAMES and JOHN ARNOLD. Dated July 29. 2d. In applying electricity to the body, it is sometimes necessary to change the battery poles connected to the rheophores or electrodes which touch the skin, so as to reverse the current. According to this invention the commutating rheophore is a pole changer and a rheophore combined. They attach for this purpose a cable, composed of two or more wires or conductors to each rheophore, one wire being connected with the positive and the other with the negative pole, so that they can be changed at will. Inside this new rheophore are springs and contact pieces, or "cocks" connected to the aforesaid wires, and by means of a small key or button, the springs are so acted upon as to change the poles. *Not proceeded with.*

3080. "Electric telegraphs." J. W. BROWN. Dated August 3. 2d. This consists in receiving instrument for cables formed of a coil freely suspended in a magnetic field, and fitted with an arm which makes and breaks contact in a local circuit. *Not proceeded with.*

3217. "Transmission of signals by electricity." W. R. LAKE (communicated by Angelo Cattaneo, of Pavia). Dated August 14. 4d. The object of this is to utilise rails as a telegraph line, the right-hand wheels of the cars being insulated from the left-hand ones. *Not proceeded with.*

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of this society, held on February 27th, Major Bateman-Champain (President) in the Chair, the discussion on Mr. Willoughby Smith's paper on the "Working of Long Submarine Cables" was continued by Mr. C. F. Varley. A paper was then read by Professor Ayrton, on "A New Method of Determining the Relation between the Electro-magnetic and Electro-static Units." At the conclusion of the paper, Mr. Cowper gave a description of his ingenious "writing telegraph," a description of which appeared in the number of the JOURNAL for March 1.

At the ordinary general meeting of the society, held March 13th, a paper was read by Professor Hughes on "Induction on Air-Telegraph Lines." An account of this paper appeared in our last impression.

PHYSICAL SOCIETY.

AT the meeting on March 22, Prof. W. G. ADAMS, President, in the Chair,

Capt. ABNEY, R.E., F.R.S., read a paper on "Obtaining Photographic Records of Absorption Spectra." Absorption spectra have hitherto been recorded by the difficult method of hand copying; but the discovery, by Capt. Abney, of a silver salt, sensitive to all rays in different degrees, renders the photographic method available. The records thus obtained are photographs of the spectrum of the naked light of the source and of that of the same light reduced by insertion of the absorbing material in its track, and these are taken parallel, so that the dark absorption lines can be readily compared. Examples of these were thrown on the screen. This method can be used as a new weapon in attacking solar physics, and determining whether or not compound bodies exist in the sun. Absorption spectra, to compare with the sun's, can be got for compound bodies by burning the matter in question in

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a flame in front of the slit and passing a bright light through the flame.

Prof. Guthrie, F.R.S., then read a paper on the "Fracture of Colloids," as illustrated by experiments on the breakage of glass plates, either by pressure or heating at the centre or round the circumference. Circular plates of glass, pressed at centre or circumference, break in radial lines. However supported, a plate breaks in the same fashion if heated in the same way. If heated in the middle, the crack is peak shaped, like an obelisk on a double pedestal, two cracks forming the outline, with sometimes a third down the middle. The two cracks unite before they reach the edge on one side, and (as afterwards pointed out by Prof. W. G. Adams) the three extremities of the two cracks all meet the edge at right angles to it. The crackage varies with the size and shape of the plates, the flame, and kind of glass; but the type is the same for all, cracks cross each other. Prof. Guthrie defined a crack as the line where the ratio of cohesion to strain is least, and likened it to the lightning flash.

Mr. W. Chandler Roberts, F.R.S., said that he had observed once a volute spiral crack in dried hydrated silicic acid; and recommended Prof. Guthrie to study cracks in agate, which is the most perfect colloid known.

City Notes.

Old Broad Street, March 27th, 1879.

The Direct United States Cable Company.—The half-yearly general meeting of this company was held at the City Terminus Hotel, on Friday the 21st March. Mr. John Pinder, M.P., the chairman, presided, and in moving the adoption of the report, an abstract of which has appeared in *The Times*, after referring to the financial results of the half-year's working, which are given in the report, said the gross earnings, in spite of the general depression in trade, had increased by £5,700, being at the rate of nearly 7 per cent., as compared with the corresponding period of 1877. The total expenses showed a decrease of £3,300, equal to 13 per cent., due, however, principally to the comparison being made with the December half of 1877, in which period they incurred expenditure for repairs. Deducting this item, in order to make the comparison a fair one, the working expenditure had been slightly reduced. It would, however, have been very considerable but for the new charge for duplex royalty, which did not appear in the accounts of 1877. He then alluded with regret to the obstruction which the present Board had met with from interested parties, and said this had continued until the other day, when the arbritation was closed by the delivery of the award. The money for obtaining this must all come out of the shareholders' pockets, and it had been literally thrown away, for the award amounted to about what the liquidator offered to the dissentient shareholders—namely, £13 per share, but with interest, say £15. The dissentient shareholder put forward in his claim as the value of his interest the sum of £76,143—that was, he took his shares as worth £76 each, the par value being £20. The actual amount awarded to him was £15,000, or £15 per share. The expenses of the arbitration would not be far short of £10,000. They had heard lately of the attempt to get up an opposition company in France. The same parties, assisted by a French combination, were, he said, what he might term the promoters of this scheme. It had astonished him to find that French companies such as those who were taking an interest in this scheme should have looked so little into facts and figures. He had been to Paris accompanied by other gentlemen interested in Atlantic submarine telegraphy, and they had interviewed the leading men connected with those financial companies. He told those gentlemen that the Direct Company had many advantages in its greater security from its connexion with the the Anglo-American Company, and that in every sense it was a much more valuable property than their new cable could be, but that the shares of the Direct Company, at the time he was speaking to them, were at a discount of close upon 50 per cent. He pointed out that the company, if brought out, must of necessity come down to the same level, and that if they persisted in their scheme after this information the moment their cable was laid competition would arise—that a shilling, or probably a sixpenny tariff, must be adopted, and although there would be a diminution in this company's receipts, it would entirely prevent the new company from paying one shilling to their shareholders, and the result this company would look forward to would be that they would in time, if they chose, become possessed of the new cable at 30 or 35 per cent. of its cost. He pointed out to them that there was no necessity whatever for a new cable, seeing that the existing cables were equal to three or four times the amount of work now offered, and seeing that since the Anglo and Direct Companies had both applied the duplex principle, their carrying power had been very greatly increased. The result of the visit, which was three months ago, was no doubt to open the eyes of the financiers, who were still wisely hesitating. He was told that the *amour propre* of the French people must be satisfied, that the whole of this great telegraph enterprise centred in England, and that France should share it, although France contributed only about 11 per cent. of Atlantic traffic. He had always held that submarine telegraphy should have an international character, and with that view and in order to meet the French susceptibility, the Atlantic companies were prepared to establish a company in France, with a French representation, using the Brest cable for the scheme to work in harmony with the existing systems. The promoters of the new scheme said they had got a concession from the French Government. It had been stated that the head of the combination was to receive £20,000 for this concession with a permanent position as president of the company. He also understood that the gentleman who was to manage the company was to secure for himself a remunerative position, and that the financiers who were said to be backing it up were to receive a very large amount of money other than what was required for the construction of the cables. As to the concession, he might mention that there was already a concession from the French Government held by the Anglo Company, which gave them very important advantages, with a preference of all the French traffic, and this concession had still eleven years to run. He was anxious to obtain a sight of the new concession. He applied at the Government offices, but found for some reason, although one of the leading Ministers told him he saw no reason why a copy of it should not be given them, up to that moment they had not received a copy of it. He was told, however, by the same French Minister that it was merely a landing right, and that the French Government would be prepared to give such a concession to any respectable company who might ask for it. As to the amount of promotion money, so far as he could learn, the two cables for which they were asking subscriptions for over £2,000,000 might be contracted for that day for about

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£1,600,000, including the cost of laying; but, allowing £100,000 for contingencies, there was between £400,000 and £500,000 for the necessity of which it was very difficult to account. He was yet hopeful that this scheme would fail like its predecessor. As to their relations with governments and companies on the other side of the Atlantic, so far they had had no difficulty. They hoped to have their position definitely recognised in Canada during the present Parliament. They were about to issue £100,000 of 5 per cent. debentures, which would be offered to the shareholders *pro rata*. The £100,000 would be applied in recouping the 7 per cent. debentures they had paid off—to the extent of £17,000, and in paying off the dissentient shareholders. On the previous night they received a telegram informing them that their main cable was repaired, that their traffic was going on as usual, and that the ship had gone to repair the shorter section. He might remind them that, notwithstanding that they had these interruptions, their revenue was not affected, owing to their arrangements with the Anglo-American Company. That was one of the very important features in submarine telegraphy—that one cable was uncertain, perhaps, while two or three constituted a valuable and secure property. Mr. W. Ford having seconded the motion, a brief discussion followed, and in reply to questions the chairman said it was a great economy to work the duplex system. He desired that the working of their system should have an international character, and he disclaimed all idea of a monopoly. They employed their cables during the day at only a fair tariff. In spare time the Press used them at quarter rates, by which the public had an enormous boon conferred on them. The report was then unanimously adopted, and a vote of thanks to the chairman and directors terminated the proceedings.

INDO-EUROPEAN TELEGRAPH COMPANY (Limited).—The report of the directors of this company states, the revenue from all sources for the year 1878 was £85,234 13s. 3d.; the expenses £45,539 7s. 1d. After charging £7,005 15s. 7d. per centage upon profits payable to Messrs. Siemens, under their Maintenance Contract, taking credit for the balance brought over from last year, £2,830 8s. 8d., and deducting income tax, there remains the sum of £35,046 4s. 8d. The directors propose to declare a dividend for the six months of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year 1878, free of income-tax. It is proposed to restore £6,000 to the reserve fund, and to carry forward the balance of £939 13s. 5d. The reserve fund will then amount to £12,461 7s. 11d. The meeting is to be held on March 31st.

DIRECT SPANISH TELEGRAPH COMPANY (Limited).—The accounts of this company for the half-year ending 31st December, 1878, show a balance to the credit of Profit and Loss of £3,588 0s. 6d.; traffic receipts £729 5s. 2d. in excess of those for the corresponding period of 1877. After providing for the half-yearly dividend on the preference shares at the rate of 10 per cent. per annum, which it is proposed to pay on the 1st April, there will remain £666 10s. 6d., of which the directors recommend that £623 9s. 3d. be placed to the reserve fund, which will then amount to £1,700, leaving a balance of £43 1s. 3d. to be carried forward. The meeting is called for the 31st March.

EASTERN EXTENSION TELEGRAPH COMPANY.—In the report of the Company, the net profit for the half-year is shown to be £69,726 16s. 6d., making, with £24,323 3s. brought forward, a total of £94,049 19s. 6d. An interim dividend of 1¼ per cent. has been paid for the six months, and it is now proposed to distribute another of like amount, making 5 per cent. for the year. The balance (£44,112 9s. 6d.) has been carried to the reserve fund, which now stands at £75,017 15s. 11d.

The directors of the Brazilian Submarine Telegraph Company have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, free of income tax, for the quarter ended 31st December, 1878, and payable on Tuesday, the 25th inst. The books of this company will be closed from the 18th to the 25th inst., both days inclusive.

At the General Meeting of the Great Northern Telegraph Company to be held at Copenhagen on the 16th April next, it will be proposed that a final dividend of 2s. 9d. per share be declared, thus, including the 5 per cent. interim dividends already paid, making the total dividend for 1878, 6⅞ per cent. It will further be proposed to add £44,444 8s. 10d. to the reserve fund which will then, after the years' outgoings, stand at £91,999 13s. 2d., and finally, that £14,837 0s. 11d. be carried forward to next account.

The directors of the Direct United States Cable Company of 1877 have issued forms of application for 1,000 debentures of £100 each, £5 per cent. debentures to enable them to pay off the amounts due to the dissentient shareholders of the company of 1873, and to put the capital account of the company on a firm basis. £5 per cent. payable on application, £20 on allotment, £25 on July 1st next, and £50 on the 1st October next. Restoration of the same company's cable was reported on March 21st.

The directors of the Eastern Extension Telegraph Company (Limited) have declared a dividend for the quarter ending December 31st last of 2s. 6d. per share, making, with the three interim dividends already paid, a total of 5 per cent. for the year 1878. The sum of £44,112 has been carried to the reserve fund, which now stands at £75,017.

The directors of the Anglo-American Telegraph Company (Limited) have resolved (after placing £37,500 to the renewal fund) to declare an interim dividend for the quarter ending the 31st inst. of 1 per cent. on the ordinary stock and of 2 per cent. on the preferred, both free of income-tax, payable on May 1 to the shareholders registered on the books of the company on April 1, leaving a balance of about £9,000 to be carried forward.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 57½-58; Ditto, Preferred, 86½-87½; Ditto, Deferred, 29½-30½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6¾-7; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10¾-11¼; Direct United States Cable, Limited, 1877, 11-11¼; Eastern, Limited, 7⅞-7⅞; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 100-103; Eastern, 6 per cent. Preference, 11½-11¾; Eastern Extension, Australasian and China Limited, 7⅞-7⅞; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10¾-10⅞; Great Northern, 8⅛-8⅜; Indo-European, Limited, 21-22; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9⅝; Reuter's, Limited 9¼-10½; Submarine, 215-225; Submarine Scrip, 1⅝-2⅛; West India and Panama, Limited, 1⅝-1⅞; Ditto, 6 per cent. First Preference, 8¼-8¾; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 3¾-4⅛; Ditto, 6 per cent. Debentures "A," 93-97, Ditto, ditto, ditto, "B," 87-92; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 29¼-29¾; Ditto, 6 per cent. Bonds, —; Ditto, Second Bonus Trust Certificates, 2½-2¾; India Rubber Co., 10¼-10¾.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

Vol. VII.—No. 149.

THE SOCIETY OF TELEGRAPH ENGINEERS.

For a considerable time past there has been a feeling of dissatisfaction among many members of the Society of Telegraph Engineers at the present condition of the Society and the conduct of its public business. These members have held the opinion that the Society, as at present constituted and operated, does not meet the wants of the whole electrical profession, and the flourishing state of electrical science; that it is too technical in its character, and too restricted in the scope of its deliberations. However unexpressed, such ideas have been prevalent; and Mr. Latimer Clark, in addressing a letter to the President and Council of the Society on this subject, has only placed himself in the position of spokesman for a large body of electricians and men of science connected with the Society. From his scientific eminence and his influence on the Council, Mr. Clark is marked out as the natural leader of the new movement.

The letter in question calls attention to the danger and disadvantages likely to occur to the Society from following too closely in the footsteps of the Institution of Civil Engineers, and assuming a rigidly professional character—a danger which Mr. Clark has repeatedly pointed out—and dwells on the advantages of attracting the support of that large and increasing body of electricians who have no connection with telegraphic engineering, or the practical application of electricity, but who pursue the subject from a pure love of science. He hints that this class may ere long become sufficiently numerous to form an independent society unless they are provided for by the existing society, and suggests that the scope of the latter should be widened so as to include them; and that it should assume a dual character and name, and become "The Electrical Society and Society of Telegraph Engineers." It cannot be denied that the Society of Telegraph Engineers, as at present conducted, is inadequate to the electrical wants of the time. Devoted as it is in practice, whatever it may be in theory, to the consideration of strictly technical subjects, it repels rather than invites the co-operation and sympathies of original investigators and students in electricity. A fascinating science like electricity has an abundance of amateurs who would gladly avail themselves of a purely electrical society where the latest advances were brought before them. As the Society exists at present, however, it is almost lost time for men of science or amateurs to attend its meetings. The enunciation of professional details, however interesting to the small group of experts diluted with a few incipient telegraphists, is a weariness of the flesh to them, and we can only wonder that some eminent professors support the Society as faithfully as they do. The time is ripe for a change of the kind indicated by Mr. Clark. Telegraph engineering no longer covers almost the entire field of electrical work. Electric lighting has suddenly established itself as an extensive and permanent application of electricity; and there is now hardly an art or science which does not engage the services of the occult agent in some way or other. It would be blind suicide, therefore, of the Society of Telegraph Engineers to pursue its narrow course, impoverishing itself by its exclusiveness, while the science to which it is in spirit at least, if not in letter, devoted, is rapidly becoming more important and fertile in results. Unless it widens its scope so as to meet the wants of the new electrical science it will certainly prepare for itself a rival; but, as Mr. Clark has said, a rival society is not wanted. The improvement of the old society would indeed be a boon; but a new society would be an affliction; for the electrical arena is yet too small to admit two competitors, without one or the other being ere long driven to the wall. The existing society holds also a strong position in its prestige, its Ronalds' Library, and its connection with the Institution. It would be unwise to foster any schism in its ranks, although such a course might perhaps appease an individual spite or two, and Mr. Clark has, we think, acted wisely in discountenancing any such action. By widening its scope so as to include electrical amateurs and investigators, and altering its title accordingly, the Society of Telegraph Engineers will greatly augment its resources, and take a new lease of life, by the infusion of fresh blood which it will receive.

Mr. Clark suggests that certain evenings should be devoted to purely electrical papers, and others to those of technical import. We cordially agree with this, for there should be a certain amount of differentiation in the conduct of the meetings; but this differentiation ought not to be carried too far, and we think that the prosperity of the Society might be endangered by allowing the scientific evenings to assume a separate character. These scientific evenings will prevent the occurrences we have seen of late at the Society, by which the most original communications of the session, the

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paper of Mr. Cowper on his "Telegraphic Pen," and Prof. Hughes' "Researches on Induction," have been hurried over, to make room for dusty lucubrations on fossil modes of signalling, and desultory remarks on the peculiarities of Cape telegraph poles. We are far from depreciating the interest and value of such useful themes as these, but we must say that a new invention, or a new research is of far more vital importance.

In conclusion, we would venture to suggest to the President and Council of the Society of Telegraph Engineers, the advisability of constituting commissions within its body for the consideration of questions which only such a body of experts are fitted to decide upon. The French Academy of Sciences and many other bodies avail themselves of a machinery of this kind, to consider and judge those scientific questions which are brought to their notice. They form, in fact, a scientific tribunal or court of science. Disputes between rival inventors about priority and equivalence of inventions, could be referred to such a tribunal, and we should through its agency, be spared the spectacle of public wrangling over electrical results which sometimes distracts the attention, and discredits the pursuit of science. We do not of course mean that the Society should busy itself with disputes of this kind; but simply that the Society should have powers to form a competent jury when its offices are required to protect the interests or reputation of its members, and decide a question which can only be decided by an authorised body of experts.

M. ADER'S TELEPHONE WITHOUT A DIAPHRAGM.

By M. LE COMTE DU MONCEL.

THE apparatus of which I have spoken in my preceding communications has been purely of an experimental character, and would not be adapted for practical purposes. The actual form of the telephone of M. Ader is that shown by the figure, which represents a longitudinal section of the instrument. The difficulty which was presented in the first instance was that of acoustically insulating the two extremities of the iron wire which is terminated at each end by metallic masses. In order to solve this problem, it was found necessary to envelop one of the two masses in india-rubber, so that this mass could be placed in a metallic case fitted to the other mass, so that no confusion of vibrations, which was referred to in my last article, resulted.

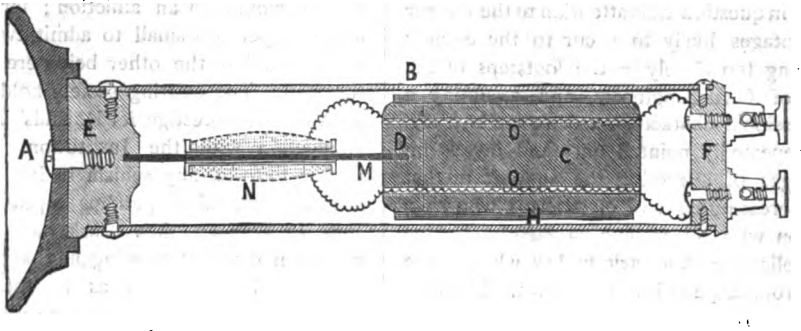
When simple voltaic currents are employed to make the instrument work, a well annealed iron wire must be employed; but, if induction currents are used, as in the Edison system, which allows the apparatus to work to a long distance, the iron wire should be replaced by a strongly magnetised needle. The induced currents cannot work telephones constructed with a simple iron wire.

The telephone is extremely portable and efficient, and, moreover, is, in outward appearance, similar to the ordinary Bell telephone.

In the figure, the following are the several parts :—

A. Ear-piece of wood.

B. Outer case.



C. Mass of lead.

D. Copper disc soldered on the lead.

E. Copper mass.

F. India-rubber mass.

H. Flexible envelope of india-rubber for insulating the vibrations of the mass C.

M. Bar of iron one millimetre in diameter, well annealed, and soldered to the mass E, and to the disc D.

N. Olive-shaped bobbin wound with fine insulated wire, and placed in the middle of the iron bar.

O O. Holes through the lead mass through which the conducting wires pass.

The whole mass C, D, does not fit tightly in the case B, but has about a millimetre of space around it.

A COMPANY is about to be formed for the purpose of working the patent of Mr. Edison's new telephonic receiver and carbon transmitter.

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PROFESSOR HUGHES ON INDUCTION.

IN our last issue we endeavoured to show as clearly as possible within the limits of a short article, the difference between the chief results of the recent researches of Prof. Hughes on Induction, and the results of his predecessors in that study. At the time we wrote we were unaware that Mr. Edison had done anything to this subject, not having seen his English patent No. 2909, dated July 30, 1877; but before our article appeared, Mr. Edison had sent a telegram to this country claiming priority of authorship of Prof. Hughes' results. We mention this fact to prevent misconception, for it might be thought that the article in question had been written subsequently to the arrival of Mr. Edison's telegram. We have examined the English patent cited by Mr. Edison as anticipating Prof. Hughes' results, and find it to contain the following passage:—"Where several line wires run near each other, the wire used for the acoustic or speaking telegraph is influenced by induction, and false sounds will be produced. I counteract this tendency by placing one or more electro-magnets 59, fig. 28, in the circuit of the speaking telegraph, and one or more electro-magnets 60 in the circuit of the adjacent wires, and bringing the opposite cores of 60 at such a distance from the cores of 59 that a certain magnetic action will be set up in 59, by induction in the opposite direction to the induction currents from the adjacent line or lines. By adjusting the distance between these magnets when the speaking telegraph is not in use, until there is not any sound at the diaphragm from the induction currents, then these currents will be neutralised, whether strong or weak, and will not produce any false sounds when the speaking telegraph is in use.

I also employ double coils of wire for the same purpose, one coil being in the acoustic wire, and the other in the wire to be compensated."

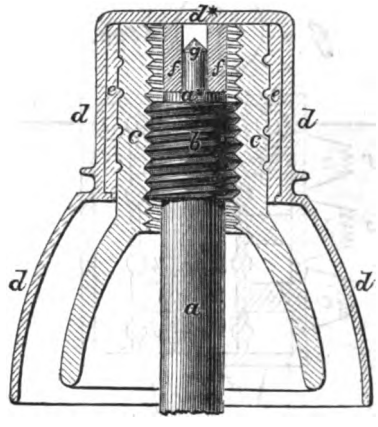
This passage contains the basis of Mr. Edison's claim as far as the English patent is concerned, and we think it is clear that what is here aimed at is simply to protect a telephone wire from the induction of neighbouring lines worked in the ordinary way and not as Professor Hughes intends, to correct the mutual induction of any number of wires, however worked. It is obvious also from the text, and it is shewn in the drawings, that Mr. Edison's magnets and coils are permanently connected in circuit; whereas, one of the distinctive features of Professor Hughes' device is to connect these compensating coils to the signalling keys, so that the latter can reverse their direction in signalling. Nor does Mr. Edison make any mention of Professor Hughes' plan of arranging the coils with respect to length, altitude, and distance, so as to make an artificial model of the actual line. In short, we can discover nothing further in Mr. Edison's specification than what has been already credited to Mr. Wilson, of Chicago, and has occurred to several of our own electricians, including Dr. Muirhead, in one of whose old note books we have seen it set down. Professor Hughes has told us at the recent meeting of the Society of Telegraph Engineers, which we report in this number, that it is not this well-known plan which he would put forward as novel, but the artificial line, and the reversing arrangement. We have yet to learn if Mr. Edison's American specifications contain these.

OPPENHEIMER'S LIGHTNING GUARD INSULATOR.

THIS invention is designed to obviate the inconvenience which arises in working telegraph lines from the breakage of insulators by lightning, and a consequent making of earth contact by the conducting wires. In order to avoid this kind of fault a lightning discharger is introduced in the interior of the insulator, which is provided with a metallic covering.

The accompanying fig. shows a section of the improved insulator.

At *a* is the metallic insulator pin connected with the post, supposed in this case to be of metal, and having formed or attached thereon a screw *b* which



supports the earthenware or other such insulator *c*, open at the top, as shown in the fig. On the outside of this insulator is a metallic cap *d*, secured by means of cement *e*, and to this metallic cap the telegraph line wire is attached in the ordinary manner.

Upon the top *a** of the insulator pin is placed a ring *f* of insulating material, and the distance to which this ring extends determines the distance between the top of *d** of the cap and an extended part *g* of the pin *a*. This distance may be varied to some extent, but that shown in the fig., which is ¼ scale, may be taken as the relative standard.

By this arrangement an effective lightning discharger is obtained within the insulator, the lightning passing through the top *d** of the cap to the post *g*, and from thence along the pin *a* to earth.

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In cases where wooden posts are used, the pin *a* may be connected to earth by means of an earth wire in the usual manner.

A NEW FORM OF SHUNT BOX.

By J. RYMER-JONES.

ALTHOUGH the introduction of a shunt between the terminals of a galvanometer G, having a resistance $\frac{G}{n-1}$ reduces the strength of the current passing through the galvanometer to $\frac{1}{n}$th of that which leaves the battery; yet, since the total resistance in circuit is at the same time reduced, the amount of the current from the battery is increased, so that the deflection on the galvanometer has a larger fractional value than that indicated by the shunt. When making experiments, it is the practice, in order to reduce the deflection to exactly the amount represented by the shunt, to introduce a compensating resistance equal to $G - \frac{G\,S}{G+S}$ or $\frac{G^2}{G+S}$ into the battery circuit.

To obviate this necessity, a shunt box has been designed by Mr. H. R. Kempe, a detailed description of which appeared in the TELEGRAPHIC JOURNAL (Sept. 15th, 1878), in which, by an ingenious distribution of compensating resistances, the total resistance in circuit always remains the same, whatever may be the value of the shunt.

The arrangement of a shunt box, having the same end in view, is shown in fig. 1; and, as it possesses one or two slight advantages, it may, perhaps, be worth describing.

Let the resistance of the galvanometer G = 5,000 ohms. It is required that the resistance in circuit between the leading wires *l*, *l*¹, connected to the shunt box, remain constant, whatever may be the multiplying power of the shunt.

If

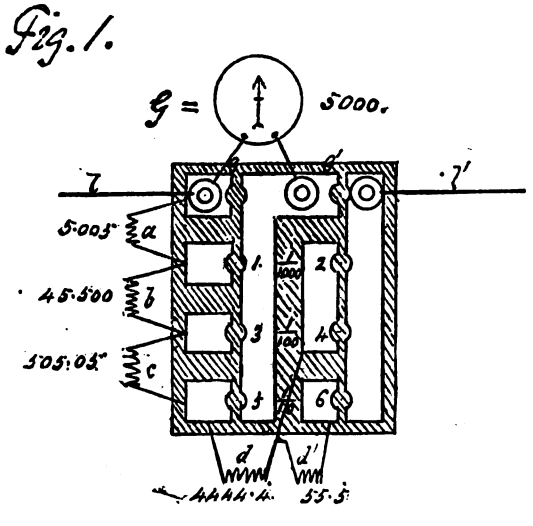
a	= 5·005 ohms =	resistance of	$\frac{1}{1000}$th	shunt s.
$a+b$	= 50·505 ,, =	,,	$\frac{1}{100}$th	,, s_1.
$a+b+c$	= 555·5 ,, =	,,	$\frac{1}{10}$th	,, s_2.

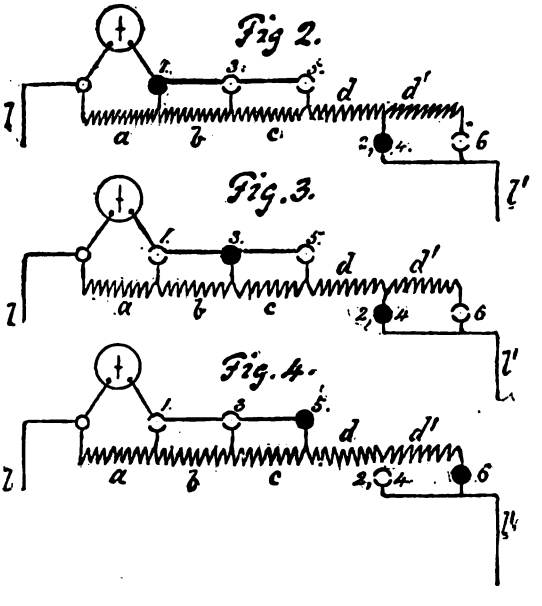
it is evident that, by introducing a plug at 1, 3, or 5, the galvanometer coils between *g*, and *g*¹, will be shunted by $\frac{1}{1000}$th, $\frac{1}{100}$th, or $\frac{1}{10}$th shunt respectively. In the case, however, of the $\frac{1}{1000}$th shunt, in accordance with the law of parallel circuits, the combined resistance of the galvanometer and shunt is equal only to 5 ohms, which, added to $b + c$, is equal to 555·5 ohms, instead of 5,000 ohms, the difference being 4444·4 ohms. Let this difference, *d*, be inserted between *c*, and 2, 4. Now, by introducing a plug also at 2, as well as at 1 (fig. 2), there will be a total resistance in circuit between *l*, and *l*¹ = 5,000 ohms, made up of the external resistance $d + c + b$ + the resistance of the galvanometer and shunt taken parallel, while the galvanometer will be shunted with $\frac{1}{1000}$th shunt.

Next let the plugs be removed to 3 and 4 (fig. 3). Then the resistance $a + b$ (= 50·505 ohms) is parallel to the galvanometer coils *g*, *g*¹, and reduces the deflection to $\frac{1}{100}$th. In this case their combined resistance is 50 ohms, which, + c + d = 5,000 ohms.

Thus, the total resistance in circuit between *l*, and *l*¹, is still equal to G, and the galvanometer is shunted by $\frac{1}{100}$th shunt.

Lastly, if the plugs be inserted at 5 and 6 (fig. 4), the galvanometer is shunted by $a + b + c$ (= 555·5 ohms, or $\frac{1}{10}$th shunt, s_2). The resistance of galvanometer and shunt, therefore, when parallel, amounts to 500 ohms, which + d = 4944·4 ohms





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only; but when the plug is transferred from 4 to 6, an additional external resistance d^1 (= 55·5 ohms) is introduced into the circuit, which brings the total resistance between l, and l^1, up to 5,000 ohms as before, so that the intensity of the current which leaves the battery is in all three cases the same. Hence the product of the deflection on the galvanometer (provided that the readings are proportional), and the corresponding multiplying power of the shunt is exactly equal to that obtained on the unshunted galvanometer.

For a set of shunts so constructed, the total resistance required, if G = 5,000 ohms, is 5055·5 instead of 5667·637, *i.e.*, a saving of 612 ohms, or nearly $\frac{1}{9}$th the total resistance, consequently the size of the shunt box is reduced. There is one less coil to be adjusted; and, moreover, the principle on which the several resistances are distributed is very clear, and readily understood by non-mathematicians. The workmanship is simple; and, although two plugs are used, this can present no inconvenience, as the two holes to be stoppered in any case are placed side by side, and the multiplying power of the shunt indicated as usual by $\frac{1}{1000}$, $\frac{1}{100}$, or $\frac{1}{10}$, being placed between them. Thus, for the $\frac{1}{10}$th shunt, plugs are inserted in 5 and 6; for the $\frac{1}{100}$th shunt, in 3 and 4; and for the $\frac{1}{1000}$th shunt in 1 and 2. When the two plugs are in g, and g^1, the whole current passes through the short circuit; but, if g be removed, the current passes direct through the galvanometer. Besides, the plug inserted at g^1, 2, 4, or 6, as the case may be, will not unfrequently be found useful as an improvised galvanometer key.

For any other galvanometer, G, the resistances a, b, c, d, d^1, will of course bear the same proportion to that of the galvanometer, as in the example under consideration, viz. :—

$$a = \frac{G}{999};$$

$$b = \frac{G}{109{\cdot}89}; \qquad d = \frac{G}{1{\cdot}125};$$

$$c = \frac{G}{9{\cdot}900}; \qquad d^1 = \frac{G}{90};$$

and if s, s_1, and s_2, represent the resistance of the $\frac{1}{1000}$th, $\frac{1}{100}$th, and $\frac{1}{10}$th shunt respectively,

$$s = \frac{G}{999} = a;$$

$$s_1 = \frac{G}{99} = a + b;$$

$$\text{and } s_2 = \frac{G}{9} = a + b + c$$

EDISON'S NEW ELECTRIC LAMP.

MR. EDISON appears to be steadily working out the electric light problem he has set himself. A correspondent of the *Daily News* writes to that paper that he has witnessed the first practical exhibition of Mr. Edison's system of division. From his correspondence we gather that Mr. Edison has discovered a new alloy, the fusing point of which is much higher than either platinum or iridium, in fact, than any known metal. "This discovery is spoken of by some of Mr. Edison's chief *employés* as the greatest achievement of his life. This alloy also reduces the cost of the valuable metals used in each lamp to such a point as to do away entirely with Professor Tyndall's criticism. It has not only reduced the cost but has increased the illuminating power so that six lights are now obtained per horse-power where only four were possible with the pure platinum coil. Six lights per horse-power is the number authoritatively stated, but Mr. Edison's chief assistant does not hesitate to predict that eleven lights will eventually be obtained for each horse-power. This is not expected from the Gramme machine, however, which is now used; but is hoped for after the completion of the new generator, which a dozen of the most skilled workmen at Menlo Park are now engaged in constructing."

Further on in speaking of the lamp, he says: "It is in reality the idea of the quadruplex telegraph applied to heat instead of electricity. The expansion of the tiny key, or, more technically, switch, breaks the current for the fraction of a second, and permits the actual, though imperceptible, cooling of the incandescent coil. This connection is made and broken many times during each second; so that to human eyes the light is constant as the sun. Now we put it out and look at the lamp again. The small coil of amalgamated wire in the little glass chamber has resumed its gray leaden hue. But we make a discovery now, at least a surprise for us, for the scientific experts of the party know of its existence. The little coil of wire is hermetically sealed in the glass chamber. It is not in a vacuum, but the chamber is filled with air. There is a sensitive spot on the metal cap in which the glass tube sits, and the expansion of the air manipulates the switch. The heat of the metal itself, therefore, is no longer relied on. The inventor explains that, after all manner of severe tests, this has been found the easiest and the least easily deranged manner of controlling the light. The difficulty of making thin plates of metal of equal density and weight rendered the previous method impracticable for small lights, although it will probably be the best form in which to secure the desired result where the lamps are to show lights of great intensity. * * *"

"The most curious and interesting feature about the light will be its cheapness and the novel method of making the charge. The price will be regulated by the number of burners in each house, and the annual rate (which it is believed will afford a large profit) has been estimated at one dollar (4s.) per year for each burner. The machinery will be run day and night, and the light may be "burned" from one year's end to another without extra charge. In a twelve-room house the present average charge for gas during the winter season is 15 dols. to 18 dols. (£3 to £3 12s.) per month. One electric light, of an average 18-candle power, would certainly prove amply sufficient for each room (excepting, perhaps, the drawing-rooms), and would cost not 12 dols. per month, but 12 dols. per year! It is more than likely that this figure is too low, as the fluctuating price of coal and many incidental expenses in operating the machinery will have to be taken into account in making the estimate, but the price will certainly be one-third or one-fourth the cost of gas after the system is perfected."

FULLER'S ELECTRIC LIGHT.

AN improved induction apparatus, for lighting by electricity, invented by the late J. B. Fuller, of Brooklyn, N. Y., is shown in perspective by fig. 1, and in section by fig. 2. The inventor's aim in the construction of this apparatus is to operate along the main electric circuit a large number of small lights, each being placed in a local circuit, whose currents are induced by the currents of the main circuit. Two magnet cores are arranged parallel

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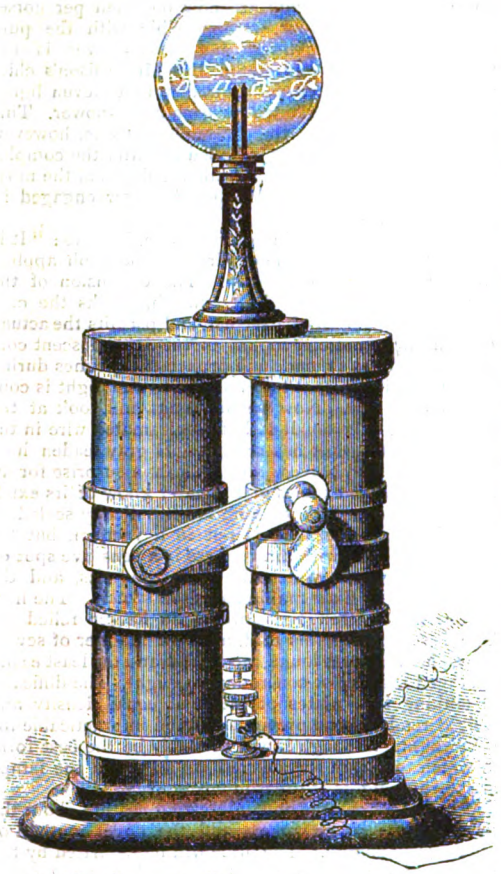

Fig. 1.

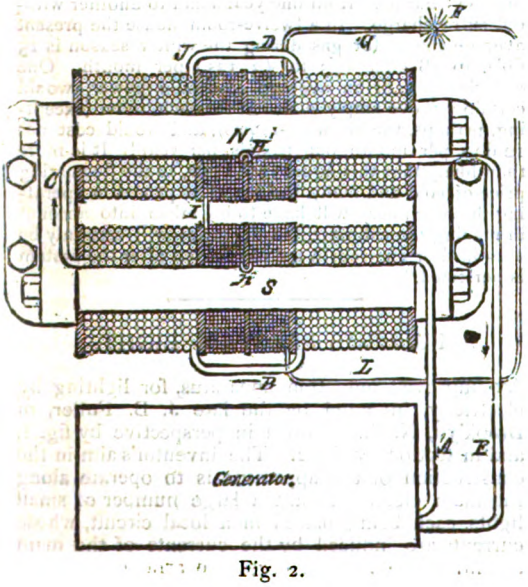

Fig. 2.

with each other, and connected magnetically at the ends, as shown in fig. 2. Around the centre of each of these cores is a soft iron head, and at a short distance from each side of this is a head of insulating material. The outer ends of the cores are coiled with insulated copper wire, and so connected together and to the electric generator as to produce, when in action, two consequent opposite magnetic poles, at N and S. A, B, C, D, and E, represent the connections of these coils. Between the iron heads and these coils are wound smaller coils of insulated wire, the fineness of which depends upon the tension of the current required.

There is an iron arm hinged to one of the iron heads, so as to swing over upon the seat connecting magnetically the poles, N and S, as shown in fig. 1. Now, if electric currents be sent through the main circuit, flowing around the large coils, and rapidly changing, in alternately opposite directions, the magnet cores will as rapidly change polarity, and these changes will induce in the small coils electric currents of greater or less tension, according to the fineness of the wire composing the small coils.

In the circuit of each of the small coils may be placed a lamp F, of minimum illuminating capacity. Two small coils may be connected together, parallel or in series, for producing a light of medium capacity; or four small coils may be connected, for producing one light of maximum capacity, as shown in fig. 2.

These connections for producing any changes in the circuits are made by means of ordinary switches, plugs, or keys. The arm which extends across the face of the coil in fig. 1, acts as a governor of the light, by strengthening or weakening the magnetic poles, and thereby varying the strength of the current.

Any number of such apparatus which the electro-motive force of the generator will supply may be arranged along the line of a conductor, the large coils being included in the circuit, and, by means of a switch in the local circuits, each or any lamp may be lighted or extinguished independently from the others.

INDUCTION APPARATUS FOR REVERSED CURRENTS.

By PROFS. ELIHU THOMSON and EDWIN J. HOUSTON.

THE following apparatus was devised by the authors for the purpose of obtaining induced reversed currents for use in electric illumination. These currents we use with a vibrating lamp, somewhat similar in construction to a lamp, a description of which has already been published.

Our method of operation is as follows: — A reversed primary current is caused to induce reversed secondary coils provided therefor. These secondary currents are caused to give vibrations to carbon electrodes, and thereby at the same time produce a partial arc between them. With sufficient strength of primary current, a considerable number of secondary currents are obtained, each of which is able to operate one of our vibrating lamps.

The use of a vibrating lamp admits of a wide range in the size of the carbons employed. When

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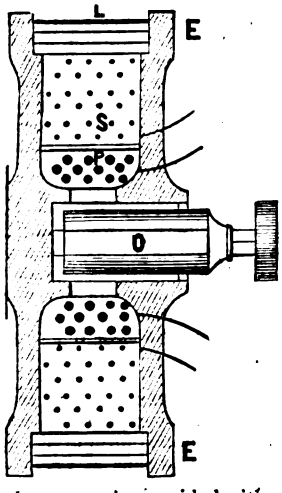
a light of very moderate intensity is desired, the carbons are made of very small size, and are placed in a closed glass vessel for protection from the atmosphere. To moderate the brilliancy, opalescent glass is used.

To obtain the highest efficiency of inductive action from a set of primary coils, the following form of induction of coil was devised: The primary coil P,



surrounding the core O, is provided with a secondary coil S, adjacent to it. The ends E, E, of the bobbin, are of made discs of iron concentric with the core O, and are slit from centre to circumference. The outer extremities of these discs are connected by wires or sheets of iron L, to one another, forming, in this manner, an induction coil encased in iron, or one whose core has its north and south extremities magnetically connected. The strength of the current developed in the secondary coil is greatest when the core O, which is movable, is inserted so that both of its extremities are in contact with E, E. By withdrawing this core, the currents in the secondary coil may be weakened to almost any desired extent. This coil is adapted to the use of primary currents whose direction is constantly changing. All the wire being completly surrounded by iron whose direction of magnetic polarization is rapidly changed, the highest inductive effect is thereby produced in the secondary coil.

The variations in the intensity of the induced currents will, of course, be followed by variations in the intensity of the light emitted by the lamp. The movement of the core may, therefore, be made to increase or decrease the intensity of the light.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

CLERAC'S TUBE.

To the Editor of THE TELEGRAPHIC JOURNAL.

March 27, 1879.

SIR,—Referring to your leading article in the TELEGRAPHIC JOURNAL for March 15th, regarding the Clerac tube controversy, you mention in that connection that I succeeded in getting great range of resistance in my carbon rheostat. If you will read carefully the full description of the instrument in question you will find that it is made up of several hundred discs of silk, with plumbago worked through the pores, and it is only by this laborious process that any great range of resistance is obtained. Had I merely used powdered carbon, as in the Clerac tube, it would have been a failure.

Regarding the microphone, and your remarks pertaining thereto, as set forth in your review of "The Speaking Telephone, Electric Light, and other recent Electrical Inventions," by Geo. B. Prescott, allow me to say that I have over fifteen drawings taken from different periodicals, a number having been clipped from the pages of the *Mechanics' Magazine*, of microphones made by different amateurs, four of which are identical with the carbon telephone, and the others bearing a great resemblance to it. It is known and is susceptible of proof that the ordinary carbon telephone may be adjusted to any degree of delicacy, and when so adjusted is as sensitive as the so-called microphone.

This being the case, I should like to have it shown at what point in the adjustment does it cease to be a carbon telephone and become a microphone?

Truly yours,

THOMAS A. EDISON.

[If you will carefully read our leader again you will see that it was to your Pressure Relay as described in the *Journal of the Telegraph* for June 1, 1877, that we alluded, and not to your recent Carbon Rheostat, which is a different instrument, and composed as you have stated. You will remark also that we only *quote* the statement that you succeeded in getting a great range of resistance in carbon by pressure. "He" (meaning yourself), says the *Journal of the Telegraph* article, "takes advantage of the property which plumbago possesses of decreasing its resistance enormously under pressure;" and the plumbago referred to is further described as being in the shape of solid discs placed upon the cupped poles of an electro-magnet, and not as powder rubbed into the pores of silk. The change of carbon resistance under the pressure of the relay armature is also given as from several hundred to several ohms. The article in question is evidently an emanation from Mr. Prescott, and has been accepted, until now, as authorised by yourself. But if it is erroneous we are glad to be told so. We greatly prefer your facts to Mr. Prescott's writings.

In the second part of your letter we note a similar disagreement between your results and Mr. Prescott's descriptions of them. Mr. Prescott tells us that "it is not probable that faint sounds were ever augmented through their (the microphones') agency, so that they could be easily recognised at a distance from their source," he doubts in short that there is any such thing as a microphone, although certain instruments have been called so.

You on the other hand affirm that your carbon telephone can be adjusted so as to become a microphone. Here again we take your word for this interesting fact; but in common fairness we must not forget, at the same time, that these new powers of the carbon telephone have been discovered since Professor Hughes published his researches on the microphone. As for Mr. Prescott, we recommend to his perusal an article in our last issue by Col. Navez, in which the distinctive features of a microphone are ably set forth. We are glad that you have addressed us personally on this matter, for your own communications are always courteously expressed and pointedly clear.—ED. TEL. JOUR.]

WE understand that the Town Council of Hadleigh, Staff., intend to light a large square in their town by the electric light.

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Notes.

THE ELECTRIC LIGHT.—Messrs. Breguet and Co., Paris, are supplying Jablochkoff candles for laboratory use, lectures, &c., at 75 centimes apiece.

THE British Electric Light Company experimentally lit the Edgware Road Station of the Metropolitan Railway on April 3, with a single light fed by a small Gramme machine, and suitably diffused by a reflector.

UNDER the title of the "New Parisian Electric Pipe Lights," small brass boxes containing rodlets of metallic sodium, to be kindled into flame by the saliva, are being sold at 1d. each on the London streets. The risk to person and property entailed by the indiscriminate use of this dangerous chemical is timely indicated by the *Sanitary Record*.

IT is expected that, as the inquiry on the subject will be extended, no Parliamentary powers for electric lighting will be granted this session.

THE MICROTELEPHONE is the name given by its inventor, Herr Julian Ockovowicz, of Lemberg University, Galicia, to a Bell telephone in which the current generated by the vibration of the diaphragm is caused to pass through the diaphragm and core as well as the coil before it enters the line. "The communication of the current with the vibrating plate," says the inventor in a letter to *Nature*, "is effected by means of two small springs which are lightly pressed by the membrane," which act as a weak microphonic contact. Three millimetres above the iron diaphragm there is a membrane of caoutchouc, so that the two enclose a film of air between. With this instrument, which is adjusted once for all, the feeblest word may be transmitted.

SYNCHRONOUS ELECTRIC CLOCKS. — Messrs. J. Edmundson & Co., of 19, George Street, Westminster, have imported a novel system of synchronising all the clocks of a hotel, railway station, or other large establishment, with one good standard clock, by means of electricity. The system may be applied very successfully to church and turret clocks, a small standard working a large dial at any distance, and we understand that it has recently been applied to the clock of St. James's, Piccadilly. At the Paris Exhibition a dial 20 feet in diameter was worked by this plan, and a medal gained. The advantage of an electrically synchronised clock is that it admits of one long seconds pendulum regulating a number of clocks with short pendulums; but it may also have its disadvantage in encouraging bad clockmaking.

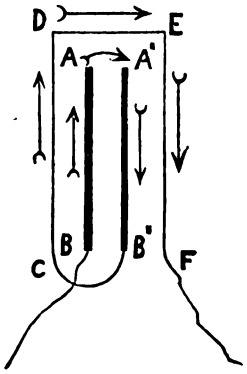
MESSRS. SAMPSON, LOW, AND CO. are about to publish Mr. J. E. H. Gordon's recent lectures on Electric Induction.

WE have received the *Science Index*, a monthly alphabetical guide to the contents of scientific periodicals, edited by Mr. A. Hildebrandt, A.I.C.E., and published at Bow Chambers, Cross Street, Manchester. This is a periodical for which the time is quite ripe, and we trust it will meet with every encouragement.

THE SWANSEA BAY TELEGRAPH STATION. — The trade of the Bristol Channel has for some time past suffered from there being no means of communication between shipowner and ship on arrival of the latter in the Channel and before her entry into port. It will be remembered that an attempt to lay a cable between the coast of Devonshire and Lundy Island was recently foiled by the owner of the island, a Mr. Heaven, refusing to allow a cable to be landed on it. The principal merchants and shipowners of Swansea thereupon drew up a requisition for appointing a telegraph station at Mumbles Head, and presented it to the Harbour Trust. The Postmaster-General agreed to erect a wire and to deal with the Swansea Harbour Trust on the same footing as a railway company. We learn from the *Cambrian* newspaper that the line is now working, and that ships make for Mumbles as a place of call "for orders." It is expected that this project will make Swansea Bay the freight market for all the South Wales ports.

CATCHING THE ELECTRIC EEL. — Dr. Sachs, the author of *Aus der Llanos*, when at El Rastro, in Venezuela, where Humboldt had captured *gymnoti* 76 years before, found that the great naturalist's well-known story of the Indian practice of driving wild horses into the rivers to exhaust the fish of their electric charges must have been an exceptional one, and not a regular custom.

AN ELECTRIC BLOW-PIPE.—In a recent communication to the French Academy of Sciences, M. Jamin brought forward a modified form of the electric candle familiar to English electricians as the invention of Mr. Wilde and M. Rapieff. This candle consists of two upright carbon rods side by side, as in Jablochkoff's candle, but without any other insulator between them



except the air, and the arc is driven to the tip of the candle by the electro-dynamic action of the current on itself. M. Jamin multiplies this action by winding one of the electrodes round the candle as shown in the accompanying figure, where A B and A′ B′ are the carbon rods, and C D E F is the electrode coiled in turns round the candle, so as to keep the direction of the current according to the arrows. When the action of the rectangle of wire on the arc is sufficient, the arc A A′ lengthens out and flares up like a gas-flame towards the attracting current from D to E. M. Jamin allows it to play upon a piece of lime, or magnesia, or zirconium, like the oxyhydrogen flame in the Drummond lamp. This has the effect of trebling the amount

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of light given off, and toning its quality from violet to yellowish green or white by admixture of the green rays from the chalk. The heat of the arc is so intense as even to fuse the chalk, and hence M. Jamin recommends the arc to chemists as perhaps the most powerful blow-flame known. The multiplying effect introduced by M. Jamin appears to us to be the chief novelty in this candle, for, if we mistake not, M. Rapieff has also applied chalk to the arc in the manner described.

A LIQUID CURRENT INTERRUPTER.—Mr. Sergius Kern sends us an account of a very interesting experiment by M. Slouginoff, which is likely to be fruitful in research. He takes the two electrodes of a battery, one of which is a thin, plain platinum plate placed horizontally, and the other is a platinum wire placed perpendicularly to the plate, and nearly in contact with it. A small quantity of water, acidulated with sulphuric acid, is next poured on to the plate. If a current from 8 to 12 elements passes through the apparatus, and the wire is made the cathode, a spot of light is observed on its point. When using 15 elements the light appears, even if the direction of the current is changed. During these phenomena the water is only slightly decomposed, and the needle of a galvanometer, if introduced into the circuit, is only slightly deflected. It was also remarked that the water under the wire is lowered, forming the shape of a cup. The bubbles of gas, arising from the decomposition of the water, in this case travel constantly round the wire, forming a very pretty figure 8. This is caused by the movements of the surface of the water, it being alternately repelled or attracted to the wire carrying the current. * * * In employing a current of 12 elements, and introducing into it Slouginoff's apparatus, a distinct sound is remarked. If the platinum plate is well polished, the water is repelled from the point of the wire equally in all directions, and some millimetres from it. The current is thereby interrupted, and the liquid advances to the wire; in this case the liquid will be again repulsed, and so on.—Crooke's *Monthly Journal of Science*.

BLACKMER'S ELECTRICAL SIGN.—The aid of electricity for rendering advertising signs more striking, has been called in by Mr. J. L. Blackmer of Boston, U.S., and his plan has been so successful that it is now patented in England. (Patent, No. 3,750, 1878.) The sign-board used by him is usually a sheet of zinc, painted or gilded, as the case may be, and the letters of the advertisement are stencilled out by punched holes. In these holes, however, are hung glass lenses or bright discs of metal, which will either transmit light from behind, or reflect it from in front. Now, such a sign would not outvie the other crystal or brilliant ones in vogue; hence Mr. Blackmer employs a small vibrating electro-magnetic apparatus to shake the sign, so that all its pendants will dangle to and fro, and scatter their glittering light.

EUROPEAN TELEGRAPH LINES.—In 1877 Russia had 94,339 kilometres of line, France 57,110, Germany 54,356, England 40,387, comprising for Russia 187,525 kilos. of wire, for France 150,506, for Germany 187,470, and for England 174,533 kilos. Switzerland counts 1 telegraph station to every 28·32 square kilos., Belgium 1 to 46·3, England 1 to 59·24, Russia 1 to 10·034. In Switzerland there are for every 1,000 inhabitants 989 telegrams, England 651, Holland 629, Belgium 544, Russia 58.

NICKEL compass needles are being tried in the French and Russian navies.

MUIRHEAD AND WINTER'S Quadruplex system is working successfully between Madras and Bombay. It is to be hoped that this novel system will be fairly tried upon our own inland lines.

NEW ZEALAND TELEGRAPHS.—We learn from *Engineering* that Mr. L. Maling, telegraph surveyor, has been ordered to construct a line to connect Dargaville and other places on the Kaipara with the system of New Zealand. The line will start from Waipu, and will be 53 miles long.

WE learn from the *Journal of the Telegraph* that Gen. Eckert has resigned the presidency of the Atlantic and Pacific Telegraph Company. His position had become a sinecure; and it is thought that he will join the proposed new telegraph combination of Railway Companies opposed to the Western Union Company.

EDISON'S Biography is being written by Counsellor Edwin M. Fox, of New York, an intimate friend of the inventor.

IN the United States Circuit Court in New York, on Saturday, March 1st, Judge Blatchford rendered a decision in the application of Clinton G. Colgate against the New York Central and Hudson River Railroad Company to restrain them from using his gutta-percha patent insulators on their cables and telegraph wires. It was stipulated by counsel that thirty days should be allowed the company in which to substitute kerite for gutta-percha on their wires. The judge granted a preliminary injunction pursuant to the bill and stipulation, and says that the question as to whether kerite is an infringement on gutta-percha as an insulator is not passed upon in this decision.—*The Operator*.

THE "Silver Wedding" of the Old and New Worlds, as the American papers call the recent banquet in honour of Cyrus W. Field, on the occasion of the twenty-fifth anniversary of the formation of the first Atlantic Ocean Cable Company, passed off very harmoniously.

THE SPECTRUM OF A GAS.—From experiments made by passing induction currents from *liquid* electrodes through Geissler tubes, Herr Paalzou is led to doubt whether a plurality of spectra is to be obtained from the same gas under different conditions of pressure and temperature.

THE AURORA.—The following observations were made at Annanatook, on the West Coast of Cumberland Gulf (lat. 66° 13′ 45″ N., long. 67° 18′ 39″ W.), by the American Howgate Arctic Expedition. The most brilliant auroras were seen in January and April. The colours observed were usually pale blue, sometimes very pale green, rarely straw yellow, and once only rose at the base. The light from the aurora was sufficient to guide the traveller in his path. It occasionally affected the ordinary compass needle, as on the 29th August when the ship's compasses could not be used while the auroral display lasted.—*North American Review*.

THE ELECTRIC DISCHARGE.—A sealed packet, deposited by M. Planté with the French Academy of Sciences on June 11, 1877, has been opened by that body and found to contain the author's researches on currents of high tension. These studies tend to prove,

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in the author's view, that the electric discharge consists of a movement or transport of a very small quantity of ponderable matter at a very high velocity.

THE Bordin Prize, which was offered by the French Academy of Sciences for "a discussion of the recent formulæ which have been proposed to replace Ampere's law of the mutual action of two current elements, and the reasons in favour of any one of these over the others," has not been fully awarded. One sealed essay was sent in which gave preference to the formulæ of M. Reynard, but which did not treat the subject completely. The judges, however, awarded a recompense of 2,000 francs to the author, who proved to be M. Reynard himself.

THE Rotation of the Plane of Polarised Light in Gases has just been effected by two German experimenters, MM. Kundt and Röntgeu, with the aid of powerful electro-magnets, made by passing the current from 64 Bunsen cells through six coils of thick wire (each comprising 400 turns) surrounding a tubular iron core. They shewed that saturated vapour of carbon bisulphide at 100° C. rotates the plane of polarisation of light in the magnetic field produced by this electro-magnet.

MAGNETO-INDUCTION CURRENTS.—According to the recent researches of Count du Moncel, if an iron stem or core wound with a coil be shifted in the direction of its axis in front of a magnetic pole, a series of induced currents in the same direction will be produced, succeeding each other, whilst the movement lasts, that is from end to end of the stem; but this effect will not manifest itself, without a special disposition of the coil upon a ring entirely enveloped by the coil, for, in this case the two opposite parts of the ring are oppositely polarised under the influence of a single inducing pole, and as the coil is wound in a different direction in relation to the two resultants corresponding to the neutral lines, the induced currents produced would be equal and contrary. For this reason M. Gramme has been obliged to divide the helix of his ring into sections, and to connect them in circuit by a collector. M. du Moncel also remarks that the induced currents in the Gramme machine are made up (1), of those which result from the movement of the coils induced before the conductor; (2) by those which are determined by the interversions of polarity of the iron ring; but the effects are the same as if those helices displaced themselves upon a fixed ring, having determinals and constant polarities.

ELECTROTYPING ON PORCELAIN.—This is now done in France with beautiful effect. The conducting basis is formed by dissolving sulphur in oil of lavender to a syrupy consistence, and mixing it under a gentle heat with chloride of gold or chloride of platinum dissolved in sulphuric ether. This mixture is evaporated to a cream, and painted on the article as a basis for the electro-deposit.

TRANSMISSION OF POWER BY ELECTRICITY.—Profs. Houston and Thomson have experimentally shewn at the Franklin Institute that powerful electric currents can be conducted by very fine wires. They sent the current generated by one dynamo-electric machine through a wire ·004 inch in diameter to a second machine, which, working reversely, gave off considerable power.

A REGULATOR FOR JABLOCHKOFF'S CANDLE.—The Abbé Lavaud has devised a simple plan for keeping the tip of a Jablochkoff candle at the same height. A small platform, which carries the candle, is floated over mercury by means of two long rods projecting from the underside of the platform and dipping into two cylinders of mercury. Each rod carries a wooden float at its lower extremity immersed in the mercury. A third rod between these two moves vertically in a central column and acts as a guide to the up and down motion of the other floats. When the candle burns down its diminished weight causes the floats to rise in the mercury and raise the platform which they carry until the point of the candle reaches its old position.

SENOR CAPPANERA, who has already translated Jenkins's "Electricity" and "Culley's Telegraphy," is now at work on "Sprague's Manual."

MAGNETISATION OF NICKEL.—According to M. Henri Becquerel, in the *Comptes Rendus* for Jan. 20, bars of nickel become saturated with magnetism much more promptly than iron bars, and hence are better suited for temporary magnetisation—a fact which might be useful in telegraphy. Cobalt gives results similar to nickel.

MAGNETISM AND CLOUDS.—The auroral or magnetic cirrus is the name given to a species of symmetrical cirrus often seen during auroral displays, and the Rev. Samuel Barber, in the latest *Quarterly Journal of the Meteorological Society*, argues that they are caused by the magnetic action of the earth or by atmospheric electricity. Cloud forms would seem to exist in the air at all times in an invisible state until a certain degree of condensation from the effect of external force is attained. Magnetic or electric disturbances are probably forces with this power. Mr. Barber was led to this conclusion by observing an ordinary lunar halo, seen through cirrus clouds (of the kind popularly known as Noah's Ark), on the night of Oct. 23rd, 1877, to change its form under the influence of the luminous waves of an aurora.

THE PATENTS BILL.—The Attorney-General's Patents for Inventions Bill proposes the following among other changes in the law:—Additional unpaid commissioners; extension of provisional protection to 12 months; publication of complete specification three months at least before end of provisional protection; only opposed cases referred to law officer; appeal by petition to Lord Chancellor against law officer's report; any person may oppose sealing; extension of term to 21 years, power of prolongation by Judicial Committee being abolished by repeal by bill; relief on accident, mistake, or inadvertence preventing payment in due time of periodical stamp duty; large power of amendment before and after sealing; improved procedure as to disclaimers and alterations; binding of Crown, with power for contractors to use, on terms compulsory use or licensing; abolition of *scire facias;* abolition of communications from abroad, and regulation of patents for imported inventions; power for law officer to take evidence on oath; power for Lord Chancellor to appoint judge of High Court to hear patents petitions; proper particulars of objections or of breaches required in all cases; patent museum provided for; lower stamps—first cost of patent will usually be £17 10s., or if no amendment before sealing £12 10s., instead of £25; patents will not extend to the colonies, which now have their own systems; the twelfth year is taken, instead of the fourteenth, for payment of the last stamp fee, in order that the public may have long notice of the patentee's intention to renew beyond the fourteen years. It will no longer be necessary for the patentee, on renewing, to produce the letters patent themselves or a duplicate thereof; the stamp will be put on the certificate of renewal, which will be issued at the Commissioner's Office.

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"KERITE" CORE.—According to the advertisement of its inventor, the kerite or artificial caoutchouc core of Mr. A. G. Day, of New York, is not injuriously affected by extremes of heat and cold experienced in any climate, nor by length of exposure in the atmosphere. It will endure long continued heat below 200° Fah., and for short intervals as high as 250° to 300° Fah.; and it may be safely immersed in boiling water. Salt or fresh water improves its insulation. It is uninjured by the roots of plants which soon destroy gutta-percha. Acids act very slowly, and only superficially upon it; while hot strong alkalies have no effect on it. Mineral oils and illuminating gas as far as is known do not deteriorate it. Samples of kerite core have been laid for a long period in the Carribbean Sea, yet the "teredo" which would have speedily destroyed other cables thus exposed, has left these entirely unharmed. Experimental lines on the Isthmus of Panama, have also been exempt from the ravages of the white ant, which makes short work of wooden poles. Kerite core is used almost exclusively by the U. S. navy department in the torpedo experiments they have been carrying on during the last three years, and it appears to have been in use in different cities of the American continent, in Egypt, and Canada for some years. Diplomas of excellence were awarded to the makers for the excellence of its insulation and durability at both the late Philadelphia and Paris Exhibitions. After this long catalogue of the virtues of kerite, it would be instructive also to know what are the weak points in it, for doubtless there will be some. The insulation resistance is probably much lower than either gutta-percha or india-rubber.

LUMINOUS DIALS.—M. Recordon, a Parisian clock manufacturer, makes known the fact that for two years he has constructed watches and clocks with luminous faces on a plan, patented by him, which does not involve the use of phosphorescent substances. It consists in passing an electric discharge through a Geissler tube filled with a gas which yields a bright light. For watches the battery, one of Trouvé's thimble forms, is, together with a small induction coil, hung at the watch chain. Pressing a spring completes the circuit and illuminates the dial.

FLAME LIGHTNING.—A flash of lightning resembling a colossal candle flame, based on the horizon and surrounded by a fainter aureole, was recently observed in the province of Rio Janeiro, Brazil.

New Patents—1879.

1175. "Electric candles." J. IMRAY. (Communicated by the Societe Generale de l'Electricite.) Dated March 24.

1181. "Iron telegraph posts. F. C. GLASER. (Communicated by J. Rauch.) Dated March 25.

1203. "Machinery for coating the surface of wax or other moulds with black lead for electrotyping." E. A. CLOWES and J. BATEY. Dated March 26.

1207. "An improved method of and apparatus for producing electric lights, whereby such lights can be more conveniently distributed and economically maintained in public places and private houses." T. A. DILLON. Dated March 26.

1229. "Improvements in apparatus for raising ships' anchors, telegraph cables, and other submerged property, such improved apparatus being also applicable to other purposes." H. W. HEMSWORTH. Dated March 28.

1242. "Electric telegraphs." E. A. COWPER. Dated March 28.

1347. "An improved means of and apparatus for transmitting messages, handwritings, and printed matter by electrical cables or wires over land or beneath the sea." T. A. DILLON. Dated April 4.

1374. "Electric batteries applicable to telegraphic and other purposes." T. J. HOWELL. Dated March 14.

1383. "Improvements in electric telegraph apparatus for transmitting orders on board ship and for other purposes." J. PITKIN. Dated April 7.

1387. "Improvements in dynamo and magneto-electric machines for generating electric currents to produce light or illumination and for electro-plating and for other purposes useful in the arts including improvements in machines or apparatus and in means, modes, and processes connected therewith." A. W. LAKE (communicated by N. S. Keith). Dated April 8.

1397. "Improvements in or preparatory to electro-plating." H. KRUPP. Dated April 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

2816. "Magnetising metal or other substances, &c." G. E. PRITCHETT. Dated July 13. 6d. Magnets are formed into hollow resonating chambers and united with microphones so as to give strong telephonic effects.

3317. "Galvanometers." E. A. OBACH. Dated August 22. 2d. This consists in forming galvanometers suitable for measuring currents of diverse strengths, by mounting the coil on a frame so that its obliquity with respect to the needle may be varied. *(Not proceeded with.)*

3367. "Galvanic batteries." J. C. FULLER and F. H. W. HIGGINS. Dated August 26. 2d. This describes the use of an amalgamated surface of iron, immersed in amalgam, instead of the zinc pole in a battery. *(Not proceeded with.)*

3428. "Ship telegraphs." J. S. GISBORNE. Dated August 30. 6d. Two order dials are electrically connected, and, by a step by step action, the hand on the receiving dial is made to show the position of that on the transmitting dial.

3528. "Magnetic appliances of garments." W. WILSON. Dated Sept. 6. 2d. This relates to improvements in magnetic belts, spinal bands, &c., whereby "dry" electric currents are kept circulating at the same time as magnetic currents. *(Not proceeded with.)*

Proceedings of Societies.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the meeting on the 25th of March, Mr. Bateman, President, in the chair, the Paper read was on "The Electric Light applied to Lighthouse Illumination," by Mr. J. N. Douglass, M. Inst. C.E.

The author showed the progress of lighthouse luminaries from wood and coal fires to the introduction

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of tallow candles, fatty oils, mineral oils, coal gas and electricity. In 1839 experiments were made by Faraday, for the Trinity House, at the Orford Low Lighthouse, with the Bude light, and in 1862, at the South Foreland with the Drummond or lime light, but the results were not so satisfactory as to lead to their adoption. In 1857 experiments were tried at Blackwall with the electric light, produced by the first magneto-electric machine of Holmes; and on the 8th of December, 1858, the electric light, obtained by Holmes' second machine and a "Duboscq" lamp, was shewn on the sea for the first time from the South Foreland High Lighthouse.

On the 1st of February, 1862, the Trinity House exhibited the electric light permanently at Dungeness Lighthouse, by Holmes' magneto-electric machines and lamps. The works for the production of the light were described, and the first cost and maintenance given. The intensity of the electric luminary was about 12½ times that of the oil luminary. The cost per unit of light per hour was 0·1165d. for the oil, and 0·1294d. for the electric light. Frequent falling off of the latter light occurred, and the oil light had occasionally to be substituted. Shortly afterwards the French lighthouse authorities established the electric light at Cape La Hêve, with the magneto-electric machines of the Alliance Company of Paris. In 1867, Holmes further improved his machine and lamp. Two of these machines and lamps were exhibited by the Trinity House at the Paris Exhibition of 1867, with a dioptric apparatus of the third order. The Souter Point Lighthouse was lighted by electricity in January, 1871. The light was adapted to a dioptric apparatus of the third order. A lower light from the same luminary as the upper one was adopted here for the first time. The optical apparatus for both lights was designed by Mr. James T. Chance, M.A., Assoc. Inst. C.E. A "Holmes" fog trumpet apparatus was also worked from the same engines as the electric light apparatus. The total cost of the works was £18,000. The cost of the electric luminary per candle per hour was 0·056d., being rather less than half of the cost per unit at Dungeness. The maximum intensity of the beam from this apparatus was about 700,000 candles. The Trinity House next established the electric light at the South Foreland High and Low Lighthouses, in January, 1872. The apparatus for the production of the light consisted of two steam engines of 20 effective H.P., four Holmes' improved magneto-electric machines and lamps, and two dioptric apparatuses of the third order for fixed white light. The cost of the additional works for these lights was £14,800. The intensity of the full power beam from the High Lighthouse was about 20 times that of the old first order dioptric oil light. The relative cost per unit of light was as 100 oil to 30·6 electric. In 1873, the Trinity House adopted, for the Lizard Lighthouses, Siemens' dynamo-electric machine and lamp, and a siren fog signal. These were driven by three of Brown's caloric engines, each of 10 effective H.P. The cost of the additional works for these lights was £14.936, and the annual maintenance, including interest on first cost amounted to £2,365 6s. 4d. against £1,016 7s. 11d. for the oil lights. The intensity for the full power beam of each light was about 330,000 candles, being about 211½ times the intensity of the oil light. The relative cost per unit of light was 100 oil to 14·04 electric. The successive improvements in the electric machines, and in the means of driving them, had reduced the cost of the electric light at the Lizard to one-ninth of that at Dungeness, and the quantity of light produced at the Lizard per pound of coke consumed was increased 20 times.

The continued growth seaward of the shingle point at Dungeness led to the removal, in 1876, of the original electric light apparatus, and the substitution of a low flashing oil light and siren fog signal for both lighthouses.

The author furnished information received from M. Allard, Director-General of the French Lighthouses, relative to the electric lighthouses at Cape La Hêve and Cape Grisnez, where Alliance magneto-electric machines and Serrin lamps had been adopted. It was intended to exhibit the electric light in the present year in a new lighthouse on the Isle of Planier, opposite Marseilles, and it had been decided to substitute the electric light for the oil light in the Palmyre Lighthouse at the mouth of the Gironde. Some information was also given relative to the electric lighthouses at Odessa and Port Saïd, these making ten in which the electric light had already been established.

The comparative cost and efficiency were shewn of lighthouse luminaries produced by all the agents at present employed, viz.:—oil, coal gas, and electricity. Coal gas, on Wigham's System, was applied to the Howth Bailey Lighthouse, Dublin Bay, by the Commissioners of Irish Lights, in June, 1865, and it had since been extended to seven lighthouses on the coast of Ireland. In 1872, the Trinity House adopted it at the Haisborough High Lighthouse. The additional cost of the works necessary for the introduction of gas at this station, was £1,996, and the annual maintenance of the gas establishment, including interest on first cost, &c., amounted to £832 4s. 3d. This light had a mean intensity of 1,173 candles, and a maximum intensity for thick weather of about 2,923 candles. In 1877 the necessary additions were made for lighting the Low Lighthouse (distant 766 yards), by gas from the same works, at a cost of £1,296. The system of Mr. Wigham had been further developed by introducing the flames of two, three, and four large burners over each other in the axis of the dioptric apparatus. In January of last year, the Commissioners of Irish Lights adopted one of the latter lights in a new lighthouse at Galley Head, near Kinsale. The maximum intensity of the four burners combined for thick weather was about 5,012 candles. The author next gave statements, shewing the comparative focussing compactness of the lighthouse luminaries which had been referred to, for utilising in optical apparatus, viz., the lights produced by oil, coal gas, and electricity. The focusing superiority of the electric luminary, compared with the best of these, was as 616 to 1. Statements were given of the comparative average cost and annual maintenance of a single lighthouse (shore station) in this country, with colza oil, mineral oil, coal gas, and electricity, as the illuminating agents, both with and without a first class 20 H.P. siren fog signal. For a maximum degree of light equal to the single or combined intensity of the luminaries of the Lizard, the cost of the more perfect electric luminary per unit of light provided was about $\frac{1}{11}$ and $\frac{6}{11}$ respectively of that of coal gas, and about $\frac{1}{13}$ and $\frac{6}{13}$ respectively of that of mineral oil, at their maximum intensities. With higher intensities of the electric luminary the cost per unit would be more in its favour, no further addition to the working staff being necessary.

From experiments by Faraday for the Trinity House, in 1836, relative to the penetrative power of lights through such obstructions as fog, mist, &c., and the more recent experiments by the French Lighthouse Authorities and by the Trinity House, with oil and electric lights, it might be assumed that, with the atmosphere so impaired for the transmission of light, that the oil luminary at its maximum intensity would be fairly visible at the fog signal range of two miles, the electric luminary at its double Lizard intensity of 16,500 candles would be visible at about four miles.

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Further, that on more frequent occasions, when the oil luminary would be visible at about 8½ miles, the electric light would be visible at the full range of 17 miles.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of the society held March 26th, Mr. W. H. Preece, Vice-President in the chair, a Paper by Mr. J. Sivewright, M.A., on "South African Telegraphs" was read by the secretary.

Describing the "route" taken by the wires, Mr. Sivewright stated that in many cases the line of poles instead of running by the side of the highways, was erected out of sight without apparent reason, this being particularly the case with the lines first erected in the colony. The crossing-places at rivers were injudiciously chosen in many cases, so that the lineman patrolling the lines often had to make a detour of several miles in order to cross. Mr. Sivewright pointed out that the crossings should only be made at fords even though the line had to take a somewhat circuitous route for the purpose. In cases where the line could not follow the highway the most direct route should be taken.

The selection of poles, whether they should be of wood or iron, must be entirely guided by circumstances. In many districts wood was not to be obtained except at a considerable cost for transit, in such cases iron poles could be used with advantage, their comparative lightness being in their favour. As a rule the wood which could be obtained was of an inferior quality and not durable; but where it was plentiful and repairs could be easily executed, this was not of great consequence. Boucherizing the timber was not found to be successful; Creosoting, although most effectual, was expensive, as creosote was difficult to obtain. The Eucalyptus was pronounced useless for poles. Olive wood, which could be obtained in some districts, was found very durable, no cases of decay at the ground-line with this wood being known. The most durable wood of all was the so-called "sneeze" wood, which, although difficult to obtain straight, was found to be practically indestructible, and it was largely used, although from its crooked growth the appearance of the lines was not picturesque.

Wooden poles were less liable to be knocked over by waggons running against them; but, on the other hand, iron poles were avoided by cattle.

As regards cost, it was stated that the iron poles first erected at the diamond fields cost 50s. each. At the present time the sneeze wood poles cost about 40s.

The wire used was almost universally of No. 6-gauge, No. 8 being occasionally employed. The wire was not found to decay. From its lightness, compound wire was recommended.

The cost of transport of the materials was excessively high, being sometimes as much as £15 10s. per ton for 50 miles, consequently lightness was extremely advisable.

At crossings, where the long whip lashes employed frequently caused contacts, No. 12 steel wire strained up tight was recommended. The form of strainer found to answer best was the "wedge." The "eccentric" strainer was a complete failure, seldom holding tight.

For fixing the insulators to the poles, *black* iron bolts were found far preferable to galvanised ones, as the latter were much more brittle. Every pole was provided with an earth wire for protection from lightning.

Bad joints were found to give great trouble from not being properly soldered. "Fletcher's" apparatus for soldering was found highly effective, paraffin oil being used as the fuel.

The insulators employed were of three kinds, viz.: "Oppenheimer's," "Andrews'," and "Siemens'" iron hooded form. Andrews' insulator was highly effective electrically. Brown ware double shed insulators were a complete failure, as thick fogs, which were frequent, lowered their insulation excessively. Oppenheimer's insulator was a good form, for the reason that the bolt was screwed and not cemented to the porcelain, and was therefore easily unscrewed when broken. In referring to this insulator, Mr. Sivewright recommended that an india-rubber ring should be used between the bolt and the porcelain.*

It was stated that great damage was done to insulators by lightning, especially on iron poles, though Siemens' form suffered less than the others.

The leading-in wires at the offices gave a great deal of trouble, as the great heat experienced melted the gutta-percha wires and caused faults.

With regard to "earths," the peculiar dryness of the soil rendered a good earth difficult to obtain. The rails of the railway were used where possible for the purpose. In some districts it was found necessary to have an iron pipe in the ground leading down to the earth plate, through which water could be poured every day to keep the earth around the plate moist.

In discussing the question of telegraphic communication with Europe, Mr. Sivewright strongly advocated a land line passing through Pretoria, Zambesi, and Zanzibar, a distance of 4,000 miles in all. The first 1,600 miles could, in Mr. Sivewright's opinion, be erected and maintained without difficulty, as the natives of the districts through which this portion of the line would pass were well-disposed and not troublesome, nor did the remaining length present insuperable obstacles.

In the discussion which followed the reading of the paper, Mr. MAYES, who has had a wide experience of the districts through which the line was to pass, expressed his opinion that the scheme was absolutely impracticable, as in central Africa the growth of vegetation was enormously rapid, and the maintenance of the line would consequently be almost an impossibility. The cost of transport would be very heavy; indeed, Mr. Mayes stated, that it was very questionable whether transport could be effected at all, as bullocks could not be kept alive, and sufficient coolie labour could not be obtained. The existence of malaria rendered the risk to the lives of Europeans very great.

Mr. FISCHER VON TREUENFELD stated that the queries raised by Mr. Sivewright at the commencement of this paper, with reference to the lines not following the highways, could be explained by the supposition that the roads were made after the construction of the lines. He also expressed his opinion that iron poles were superior to wooden ones, in that the cost and trouble of their maintenance would be small.

Mr. SARGEAUNT, who is Crown Agent for the Colonies, and who has had considerable experience of African travel, said, that although at first he doubted the feasibility of a Trans-African land line, he had since reason to alter his opinion on the subject; but although he considered that a land line would eventually be erected, he strongly urged the necessity of telegraphic communication with Europe being effected as early as possible, and this could only be done by means of a cable. Mr. Sargeaunt warmly eulogised Mr. Sivewright's services to the Cape Government in bringing the telegraphic communication into a high state of efficiency.

Major WEBBER pointed out that the telegraph had been of great use during the Caffre war of 1878, but stated that the material at present available at the Cape was too heavy for military use. At the present time

* This has been done by Mr. Cordeaux in his Patent Insulat . See TELEGRAPHIC JOURNAL, Vol. VI., p. 286.

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there were being sent out to the Cape for the latter purpose 100 miles of line, 30 miles being ground cable, 20 miles light wire with poles, and the rest wire only; wheel transport was also being provided, but Major Webber thought that pack animals would be the most advantageous form of transport.

Mr. SPAGNOLETTI suggested kyanizing as a good method of preserving timber for poles, stating that timber so prepared had been known to last for 30 years. He also drew attention to a new form of insulator of Mr. Oppenheimer, which was intended to act as a lightning guard. The bolt in this insulator was carried nearly up to the top of the porcelain, and was pointed.*

A vote of thanks having been proposed to Mr. Sivewright for his paper, the discussion was then adjourned till the next meeting.

AT the ordinary general meeting held April 9th, Major Bateman-Champain, President, in the chair, the adjourned discussion on Mr. Sivewright's paper on "South African Telegraphs" was continued.

Mr. A. BELL drew attention to a new form of insulator as likely to be of service for use in the Colonies. In this insulator the wire was secured by having an ingot of metal cast on it, the wire fitting in a groove at the top of the insulator and being secured by an iron pin passing through holes in the porcelain. The form of insulator Mr. Bell stated would be very effectual as regards good insulation, as but a very small surface of the wire touched the insulator. Moreover, the wire being firmly secured could not rub and thus wear off the galvanised coating, which wear, if it took place, would cause the wire to rust very quickly, and the rust to spread over the lip of the insulator and lower its insulating properties.

With reference to breakage of insulators by lightning, Mr. Bell said that a wire connected with the earth wire and bent over towards the line wire and in close proximity to it, would be probably highly effectual.

Mr. SPAGNOLETTI stated that he found several instances of bad binding causing chafing and subsequent breakage of the wire at the insulator. Speaking of preserving the wooden poles, he remarked that ordinary timber so preserved would last for 20 or 30 years without decay. Mr. Spagnoletti said that the difficulties of transport of materials in Africa might possibly be got over by the employment of elephants.

Mr. LATIMER CLARK said that a form of insulator with a lightning guard had been sent out to India several years ago, by Colonel Robinson, but that he had not heard whether it had been used with success.

Mr. PREECE, in commenting on Mr. Sivewright's paper, said that the question of most interest raised by it was that of a land line versus a cable to complete communication with Europe. In discussing the question, Mr. Preece expressed his opinion that taking into consideration the various accidents to which land lines and also cables were liable, there was not much to choose between the two schemes. He considered the chances of the wire being interrupted by natives as small, and also the unhealthiness of the climate as exaggerated. As to the erection of the line, Mr. Preece pointed out that the line might be divided into sections of 400 miles each, and stores would have only to be carried that distance. The question of cost he considered as the same in both cases.

Kyanizing, in Mr. Preece's experience, was not successful, as although for ordinary timber as used in bridges it might be effectual, yet, when applied to telegraph poles, they were always found to decay at the wind and water line; creosoting was the only really successful process. Compound wire was stated to be unsuccessful, as it split, and the coatings became separated from the centre wire. The American electrotyped wire was inferior both in conductivity and strength to ordinary No. 8 galvanised iron wire, as used by the Post Office.

Sir CHARLES BRIGHT differed from Mr. Preece as to the relative merits of a land and an ocean line, as he considered a cable preferable. A land line erected in Persia, where the obstruction from natives were comparatively small, took several months longer to complete than a cable down the Persian Gulf.

Professor AYRTON drew attention to the underground system employed in Germany, as showing that open work was considered there as undesirable. With regard to the insulators referred to by Mr. Latimer Clark, he stated that the form had been used at terminal poles, and with success.

Dr. SIEMENS preferred a cable to a land line as being less subject to accidents. With regard to the route which the cable should follow, he strongly advocated the cable being laid between Southern India and the Mauritius, as a coast cable would be more subject to accidents than a deep sea one; it was especially objectionable to have a coast cable in shallow water in the tropics. An underground cable through Africa was not advocated; but he expressed his opinion that such cables would be more generally adopted than at present. While advocating a cable at the present time, Dr. Siemens thought it probable that a land line would eventually be erected in addition.

Major CHAMPAIN said that a land line ought to be erected about 100 yards from the main road, but so as to be in sight of a man on horseback. Iron poles he very strongly advocated as being cheaper in the end than wood, and in Africa, where transport was expensive, he thought they would be cheaper, in the first instance, from their lightness. In Persia, the poles were protected from cattle by erecting low rubble walls around them, or by surrounding them with a trench. As regards land lines, he stated that although the Persian line was at first thought to be impossible, it was afterwards erected without very great trouble. The growth of tropical vegetation, Major Champain stated, was probably quite as heavy in certain parts of India as in Africa, and yet it was found possible with a little trouble, to keep the wires clear.

In commencing the discussion of Professor Hughes' paper on "Induction on aerial lines," Mr. Preece gave some results of experiments he had made to determine the effect of induction between wires through which heavy currents were passed, as in electric light circuits. The results showed that induction was not prevented by surrounding the wires by large iron pipes, as in the ordinary street work. As a consequence of these experiments it was decided by the Postal Telegraph authorities to oppose the placing of electric light wires laid under ground. With regard to Professor Hughes' method of neutralising induction, Mr. Preece stated that the effects of induction were not felt to any appreciable extent on lines, and that, therefore, the invention would not be of use.

Professor HUGHES, as the result of experiments, stated that iron tubes in no case would shield wires enclosed in them from induction. As to induction between wire and wire, he stated that in France, where all the wires on the poles were in the same plane, induction was very strongly felt, the effect on a neighbouring wire being equivalent to a battery of one-tenth of the working power. The effect was particularly noticeable on his form of printing instrument. In speaking

* A description of this insulator is given on page 127 of the present number of the JOURNAL.

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of the claim made by Edison to be the discoverer of the method of neutralising induction, Professor Hughes stated that as the patent specification of Mr. Edison had not been published, it was quite impossible for him to say whether any distinction existed between the two methods, especially as none of Mr. Edison's representatives appeared to be present at the meeting to support the claim.

The meeting then adjourned till April 23rd.

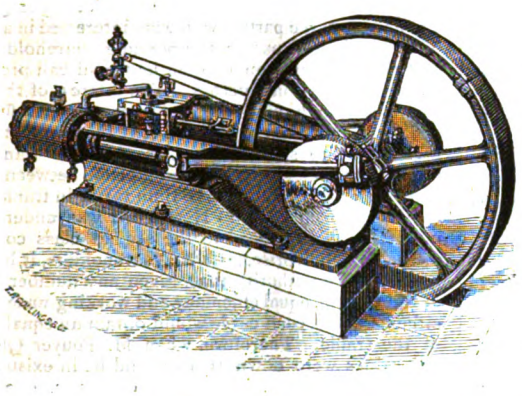
General Science.

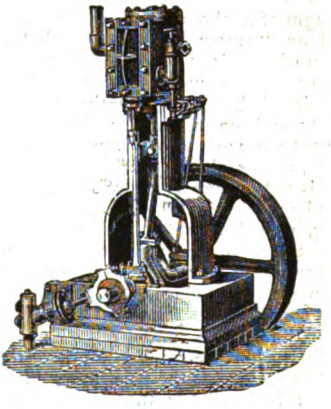
ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

III.

Engines of the "Atlas" Engine Company.

In the design of the Horizontal "Atlas" Engines, a figure of which is here given, it has been sought to embody all the advantages of the original "Allen" Engine frame, together with an improved shape and finish in the details. Thus, while the guide bars, front cylinder, cover and main carriage are cast in one with the bed, the base is carried out into a square shape so as to facilitate foundations and ensure a more even distribution of the bearing surface and of the holding-down bolts. The square bars have been retained, but the crosshead is of improved design, with slippers adjustable by means of a wedge and screw so that it can be slipped on in any position. With the exception of the guides and the outline of the base all straight lines and angles have been done away with, so that the design is harmoniously curved through. The frame being of the box girder pattern is light and strong. The combination of the slide-valve spindle with the feed-pump plunger provides the former with the best form of guide in the right place, and has also the advantage of throwing only a "tensional" strain on to the eccentric rod.





In the "Atlas" Vertical Engines the vertical tubular frame merges into a square hollow base in which are cast two carriages to receive a double crank shaft. The guides are cylindrical, form part of the frame, and are cast with oil boxes opening outside the frame. Both horizontal and vertical engines are made to gauges, so that any part can be easily replaced at any time.

The "Atlas" Engine Company have been trying several kinds of governors, with a view to finding out the best, and hope to introduce shortly a very superior one.

When combined with vertical boilers the "Atlas" engines are fixed on a hollow foundation plate, forming a tank, in which the feed water is admitted and is warmed by the heat of the under part of the furnace.

We may mention that "Altas" Engines were selected to drive the Dynamo-Electric Machine at Aston, near Birmingham.

Mechanical Production of Speech.—Mr. W. H. Preece and Mr. Augustus Stroh, the eminent mechanician, recently brought before the Royal Society the results of a classical study in acoustics, which really form the first step towards mechanically building up speech. The phonograph has given a great stimulus to this subject; but its own efforts while being mere *reproductions* of speech, are somewhat imperfect, owing to the merging of the labial and dental sounds into one another, and the absence of all the sibilants and generally of the "noises" of speech. Helmholtz's theory of vowel sounds is this:—Vowels are compound musical tones, or resultant sounds formed by the combination of certain components or simple tones called partials. The first partial, which determines the pitch of the whole, is called the prime, and the others its upper partials. The partials depend upon the reinforcements due to the cavity of the mouth. They do not depend upon the pitch of the prime alone, or on the grouping or harmony of the partials alone, but on both. The ear must distinguish each component; it must recognise the kind of cavity producing the reinforcements, and therefore it determines the different vowels. This theory has been partly confirmed recently by Messrs. Fleeming Jenkin and Ewing, by an analytical examination of phonographic tracings, fully described by them in a paper read before the Royal Society of Edinburgh.

The method pursued by Messrs. Preece and Stroh was the reverse of that followed by Messrs. Jenkin and Ewing. They first constructed a new instrument for

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recording the curves of vowel sounds, that is, the motions of the sonorous air after the manner of Barlow's Logograph, or Leon Scott's Phonautograph. For this purpose they selected a vibrating diaphragm of thin sheet india-rubber rendered rigid by a cone of paper, as giving the best results, and connected it to a fine glass pen, which recorded the vowel vibrations on a strip of moving paper. They next had constructed an ingenious and beautiful "synthetic curve machine" (the work of Mr. Stroh), which, by an arrangement of toothed wheels actuating a marking lever, produced these vowel curves mechanically, and showed how vowel tones are compounded of primes and harmonic upper partials. It also showed how *simple* tones can be produced by simple harmonic curves, and *compound tones* by the simultaneous action of several simple tones. The point of the marking pen of the lever itself swings backwards and forwards precisely in the same way as does a particle of the air conveying the tones.

Having thus mechanically produced vowel curves, the next aim of the authors was to mechanically produce the vowel sounds themselves by superimposing partials on a given prime. They therefore constructed an apparatus upon which discs were fitted, whose peripheries were cut in an exact copy of the curve produced by the "synthetic curve machine." These curves were transmitted by vibration to the receiving diaphragm of a phonograph, and the instrument really formed an "automatic phonograph," as far as the emission of sounds is concerned; but it is clear that this is not a very apt name, for there is no writing of sounds implied. The "synthetic sound machine" would have been a happier title perhaps. By this contrivance a variety of results were obtained, for example, it was shown that our knowledge of vowel sounds is not perfect, since vowels cannot be produced exactly by mechanical means: something being always missing, probably the noises due to the rush of air through the teeth, and against the tongue and lips. It also shews that a vowel sound of the pitch of the prime may be produced by certain partials alone, without sounding the prime at all. The beat, in fact, becomes the prime.

Another point remaining for investigation arising out of this inquiry, is the true theory of the loudness of sound. It is thought by the authors that loudness does not depend upon amplitude of vibration only, but also upon the quantity of air put into vibration; and, therefore, there exists an absolute physical unit in acoustics analogous to the unit of quantity of electricity or quantity of heat, and which may be called the quantity of sound. In fact, in the automatic phonograph the diameter of the sounding disc ought, if it were possible, to vary with the pitch of each note, to produce equal intensity of sound.

The authors are now engaged in pursuing this inquiry into the consonantal sounds.

City Notes.

Old Broad Street, April 10th, 1879.

ANGLO-AMERICAN TELEGRAPH COMPANY.—The directors have issued the prospectus of a new company to be called the "Compagnie Française du Cable Transatlantique," with a capital of 20,000,000 francs, (£800,000). This project has for its object the re-transfer to a French Company of the working of the telegraphic line between France and America, and providing for the renewal of the present cables. The Anglo-American Telegraph Company are the owners of this line, which they acquired from the Societe du Cable Transatlantique Français. All the telegrams between France and America are transmitted direct via Brest, St. Pierre and Duxbury, except in cases of interruption, when they are sent by the three English cables. The four cables above mentioned are more than sufficient for carrying all the present traffic, and they are equal to the transmission of a much larger correspondence. The Anglo-American Company agrees to transfer to the French Company the Concession granted by the French Government, dated 6th July, 1868, and the working of the present cables from Brest to St. Pierre, and from St. Pierre to Duxbury, and the use of the stations. Further, the French Company will be admitted to the joint purse arrangement existing between the Anglo-American and Direct Cable Companies.

At an extraordinary general meeting held on the 8th inst. at the City Terminus Hotel to receive the above report from the directors, Lord Monck, the chairman, presided, and at the outset of his remarks said the notion of getting up a company in France to compete with the companies in England was by no means a new one, and the rumours as to such an intention were always connected with the name of M. Pouyer Quertier. There were three parties who were interested in a scheme of this sort—the public, the possible shareholders, and that class of gentlemen whom he would call promoters, financiers, and constructors. The interest of the public was solely in having the traffic conducted efficiently, and it was not even pretended that this competing line was meant to subserve any great public want, or to improve the telegraphic communication between Europe and America. The average time taken in transmitting a message from Paris to New York was under twenty minutes. With regard to the second class concerned in such an enterprise, possible shareholders, it had been laid down by authority that, given any number of telegraph lines of equal efficiency and working under similar circumstances, each cable would obtain an equal amount of the traffic. Therefore, when M. Pouyer Quertier's two cables were down there would be in existence six cables, three belonging to the company, one to the Direct United States Cable Company, and these two, and consequently the proportion of traffic obtained by M. Pouyer Quertier would be one-third. That, however, was assuming that all things were equal; but this company and its colleague, the Direct Company, had by special agreements the right to bring almost every message which crossed the Atlantic from America here, and they had priority in, he believed, all European countries over any other company which might exist—that was to say, the Governments of all European countries, France included, were bound to send all messages transmitted to them by these two companies' lines, unless the sender directed to the contrary. Did any reasonable man think that 8 per cent. would be a fair allowance to make for these enormous advantages? But even such an allowance would reduce M. Pouyer Quertier's proportion of the traffic from one-third, or 33 per cent., to 25 per cent. In his prospectus that gentleman coolly and quietly said he expected to get 48 per cent., but he had dropped down to 40 per cent. He (the speaker) asserted, however, that he would not get more than 25 per cent., or £178,750. The working expenses, taking the expenses at one-third more than those of the Direct United States Cable Company, who worked only one cable, would be £67,000, the reserve, which should be laid by

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in the same proportion as the Anglo and Direct Companies adopted, would be £100,000, and M. Pouyer Quertier's own estimate for the redemption of his bonds was £32,000, making in all £199,000, or about £11,000 more than he would receive as his share of the traffic. Could any man of common sense conceive that a third participator in the same revenue would be better off in the market than the Anglo and the Direct Companies? There was no pretence that the gross revenue of Trans-atlantic telegraphy would be increased by this operation. He was sorry to say that the Direct Company and themselves commanded about the same proportional price in the market, or a depreciation of about 40 per cent. (A Voice. —45.) With regard to the third class interested in such a project as this, promoters, financiers, constructors, and so forth, he had not a word to say against the class as a whole, but he thought their operations ought to be scanned very closely and criticised very sharply by those who proposed to be shareholders in their undertakings. M. Pouyer Quertier and his friends threw a very graceful haze over the whole thing as to where the money was going, yet he shrewdly suspected that a great deal would go into the pockets of men who would not give any great value for it. When they saw that this scheme was taking a definite shape they took measures to protect the shareholders' interest, and they sent over to Paris and tried to make terms; but they led to nothing, and they had now to meet the question boldly. They, therefore, asked the shareholders to arm the directors with such powers as would enable them to undertake the war effectually on their behalf. Their colleagues of the Direct Company were entirely with them. The report and the memorandum annexed to it would reveal to the shareholders the steps they proposed to take in order to meet the French company. He might add that if the company which they themselves had projected should be constituted, it would work in harmony with this company, and there would be no change of traffic and no important alteration in the management of the business without the concurrence of the company and of the Direct Company. He then moved a resolution authorising the directors to take any steps they might deem requisite or desirable for giving effect to the project set forth in the printed report of the directors, dated the 31st ult., and the memorandum annexed thereto, &c. Sir Daniel Gooch, M.P., a director, seconded the motion, which was at once carried unanimously without discussion—a circumstance which caused some surprise to not a few of those who were present. A vote of thanks to the chairman terminated the proceedings.

MEDITERRANEAN EXTENSION TELEGRAH COMPANY (LIMITED).—The Forty-third Ordinary General Meeting of the shareholders of this Company was held on Wednesday, the 2nd of April, at the Cannon Street Terminus Hotel, under the presidency of Sir James Carmichael, Bart., the chairman of the Company. The report stated that in the past half-year there had been a falling off in the revenue as compared with the previous half-year, which was due to the suspension of traffic between Otranto and Corfu for almost the entire period of the last quarter, in consequence of the cable being injured. They had been compelled to call on the Government for the full amount due under the guarantee. The Chairman, in moving the adoption of the report, said: I have to express very great regret, both on my own account and that of my colleagues, that this meeting has been so long delayed. You are aware that it ought to have taken place about a month or six weeks ago. This delay, however, was unavoidable. It has occurred through an objection on the part of the Treasury to the form in which our accounts were sent in. We very properly, as we thought, charged the cost of our repairs, as usual, against the revenue, but the Government auditor, on the contrary, was of opinion that we should have taken the cost of these repairs out of our reserve fund. Well, we pointed out to the Treasury that that was a very unusual proceeding—that in all telegraph companies it was customary to charge the cost of the repairs of each half-year against the revenue of that half-year, and to keep the reserve fund untouched, except in the case of a partial or total renewal of cables, in which case the reserve fund became available. After considerable discussion, I am happy to say that the Treasury took our view of the matter, and eventually the accounts were passed by the Government auditor in the form in which they were at first presented. That leaves us in a position to recommend the usual dividend on the ordinary and preference stock, and to keep our reserve fund untouched for future occasions if necessary. Therefore, although the delay has been productive of some inconvenience to the shareholders, still it resulted in a favourable arrangement with the Government officials. With regard to these repairs, as stated in the report, the one respecting the repairs to the cable between Corfu and Otranto has been carried out successfully, and the cable is now in good working order. I regret to say, with regard to the Alga-Grande cable, one of the cables between Sicily and Malta, we have been obliged for the present to abandon any further efforts to repair it, and I should hardly be justified in recommending a further expenditure on the cable. The cable was laid some twenty years ago, and at that time, as you are very likely aware, it was not the custom to give the wire coating of the cable any further protection. The cable laid since then, which has been down some ten years, has been covered with a composition commonly known by the name of Clark and Bright's patent, which preserves the iron from the action of the salt water. There is the second cable, now in working order, between Pozzallo and Malta; it is in excellent order, and capable of doing all the business that we have. At present, therefore, I should not advise further expenditure on the Alga-Grande cable. Hereafter, it may be a question of renewing it, but not just now. I don't know that I have anything further to say, except that I shall be happy to answer any question from any shareholder. I now move the adoption of the report and accounts. The motion having been seconded, the report was unanimously adopted, and the dividend on the special preference stock, less income tax, and a dividend at the rate of 3 per cent. per annum on the ordinary stock, tax free, were declared.

INDO-EUROPEAN TELEGRAPH COMPANY (LIMITED).—The half-yearly general meeting of the shareholders of this Company was held on Monday, the 31st of March, at the Cannon-street Hotel, under the presidency of Colonel James Holland, the chairman. The chairman, in moving the adoption of the report (an abstract of which was given in our last issue), said it was no doubt a matter of satisfaction to the shareholders, as it was to the directors, that they are able to present a report which was so much more satisfactory than that of 1877. That year unfortunately was marked for them by the Russo-Turkish war, owing to which between sixty and seventy miles of their line of communication was destroyed, and so remained for several months. They had, however, formed a reserve fund, and that, combined with the energy of the Board, and very greatly with the energy of the contractors, Messrs. Siemens, enabled them to establish a line through the Caucasus, and the effects of the disaster were not such as to deprive the shareholders of a dividend. Although the accounts of the past year might have shown a better result, they showed that the amount received as gross revenue was larger than on any previous occasion, being over £90,000. There had been continued depression in trade, and though there were some improving prospects the

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depression still continued, and so long as it existed they could not expect the average amount of business with a derangement of mercantile transactions in India and other places. The total receipts of the past year, however, had been satisfactory, and there had been a steady increase, the dividend having always been progressive, with the exception of 1877. They recommended a dividend for the past year of 6 per cent., adding £6,000 to the reserve, thus replacing the fund in its former position. Excepting a few amounts due to them from Government, every shilling of the debtor and creditor accounts had been cleared off. The gross expenses for the past year were stated at £45,539, but a sum of £589 had been expended in the purchase of the freehold of a station, and after deducting some further extraordinary amounts, the expenses were actually £500 or £600 less than those of 1877. With regard to the reserve fund, he presumed that there was no one who would question the policy of having a good reserve. The reserve fund had been their salvation in the past, and might be again, and therefore it would require no eloquence on his part to impress upon the shareholders the necessity of adding to that fund. Their policy had been to pay everything out of revenue, keeping the capital at a *minimum*. As to their claim against the Russian Government for the destruction of the wire, he had hoped to be able to announce that it had been met by the Government; but although they had met with no rebuff, the claim still remained unsettled. Government powers were slow in motion when the payment of money was concerned, but the directors would not relax their efforts, although they must not be impatient. Such a claim as theirs on the Russian Government was never refused by any civilised Government, and he trusted to hear that a considerable amount had been paid to their account, and that before long the whole claim would be satisfied. The system adopted some years ago by which representatives of the Press at distant stations were enabled to transmit messages at quarter rates when the wires were not occupied for the ordinary business of the Company had worked well to the advantage of the Press and the general public. They had made strenuous efforts, in conjunction with the Eastern and the Eastern Extension Companies, to extend this privilege still further; but he regretted to say that they had not hitherto met with much success, foreign Governments, for various reasons, finding it difficult to aid the movement. The directors would, however, still continue their exertions to carry out this object. With regard to the International Telegraph Conference, which was held every three years in one of the principal cities of Europe, it would this year take place in London, and the Postmaster-General had invited the Company and the representatives of other companies to attend it. The directors had accepted the invitation. They should strive to repay the warm hospitalities they had received abroad—whether at Vienna, St. Petersburg, or Berne, and he hoped that our Government would not be behindhand in repaying the hospitalities of foreign Governments to the British representatives at these conferences. He concluded by moving the resolution. A director seconded the motion, which was at once unanimously adopted, and the dividend as recommended was then declared.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).—The half-yearly general meeting of the shareholders in this Company was held on Monday, the 31st March, at the offices, 106, Cannon-street.

Mr. Neil Bannatyne, the chairman, presided, and in moving the adoption of the report, a brief account of which appeared in our issue of the 1st inst., said he had no doubt the shareholders had observed that the feature of the accounts was an increase in the working expenses for the past half year, but he was glad to be able to state that the increase arose from exceptional causes, some of which would not occur again, and others not for some years. The details showed that the normal working expenses had not increased, and that the Company could carry on a large increase of traffic with the same expenses. The traffic did not come up to his expectations, but it had enabled the directors to increase the reserve fund to £1,700, and to carry forward a small balance after paying the preference dividend. They had not lost any of their customers, but they had had fewer telegrams; the area, however, from which they drew their customers was as great as ever. When a revival of business occurred he had no doubt the position of the Company would improve, but there was no immediate prospect of an improvement in the depression of trade. He concluded by moving the adoption of the report. The motion having been seconded, after a few remarks, was eventually carried unanimously.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY.—The directors submit the accounts of the Company for the year ending December 31, 1878, showing the gross revenue to be £26,310 16s. 2d., and the expenditure £14,732 6s. 11d., leaving a balance of £11,578 9s. 3d. Of this amount £10,996 11s. 7d., is absorbed by payment of the Debenture Interest, and the directors propose to carry forward the balance, amounting to £581 17s. 8d., together with the balance brought forward from the old Company, amounting to £1,250 2s. 9d.

The Globe Telegraph and Trust Company (Limited) notify that interim dividends for the quarter ending 18th April, 1879, of three shillings per share on the Preference Shares, being at the rate of 6 per cent. per annum, and two shillings per share on the Ordinary Shares, being at the rate of 4 per cent. per annum, will be paid on and after 21st April instant.

Information was received on the 29th ult., by the Cuba Submarine Telegraph Company (Limited), of the repair of their 1870 Cable between Cienfuegos and Santiago de Cuba, thus restoring duplicate means of telegraphic communication with the West Indies.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 55-56; Ditto, Preferred, 85½-86¼; Ditto, Deferred, 26-27; Black Sea, Limited, —; Brazilian Submarine, Limited, 6¾-6¾; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 1½-2; Direct Spanish, 10 per cent. Preference, 10½-11; Direct United States Cable, Limited, 1877, 10¾-11; Eastern, Limited, 7⅞-7⅞; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 100 103; Eastern, 6 per cent. Preference, 11¼-12; Eastern Extension, Australasian and China Limited, 7¼-8¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; German Union Telegraph and Trust, 7⅞-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10¾-11; Great Northern, 8-8½; Indo-European, Limited, 21-22; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9¾; Reuter's, Limited 9½-10½; Submarine, 215-225; Submarine Scrip, 1¾-2¼; West Coast of America, Limited, 1½-2; West India and Panama, Limited, 1¾-1¾; Ditto, 6 per cent. First Preference 8¼-8¾; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 3¾-4¼; Ditto, 6 per cent. Debentures "A," 93-97, Ditto, ditto, ditto, "B," 87-92; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 29½-30; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2½-2¾; India Rubber Co., 10-10½.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 150.

THE NEW THEORY OF TERRESTRIAL MAGNETISM.

IN our issue for the 1st March, we gave a preliminary notice of the new theory of terrestrial magnetism developed by Professors Ayrton and Perry. All previous explanations of the earth's magnetism have been based either on the existence of one or more permanent magnets inside the earth, or on thermal electric currents produced by the rotation of the earth under the sun's action. But the thermal currents thus generated would probably be totally insufficient to account for the earth's magnetism; and we have no reason, beyond the fact that the earth acts as a magnet, for assuming the existence of permanent magnets in its interior. The newly proposed explanation, however, differs from all that precede it, in that it requires *solely* the rotation of the earth and a static charge of electricity on its surface as its elementary conditions. As regards the existence of the first condition—the earth turning round on its axis—there can be no doubt; and the second—that the earth is a charged body—is more than probable; for many phenomena lead us to conclude that the various bodies of the solar system have different electric potentials, therefore, some, or all of them must have independent electric charges. And not only this, but Sir Wm. Thomson has concluded, as the result of many experiments, that all the phenomena of atmospheric electricity ordinarily observed, would be just the same as they are if the earth were *negatively* electrified and the atmosphere without charge. Now such a *negative* charge would, as explained by Profs. Perry and Ayrton, not only by its mechanical rotation produce a magnetic potential inside and outside the surface of the earth, but would cause our small magnets to be deflected in the same direction as we now see them. For since the marked poles (English, north; French, austral) are deflected towards the north, the earth's magnetic pole in the northern hemisphere must be of course an unmarked pole (English, south; French, boreal), and to produce such a pole would require a positive electric current to flow from east to west round the earth, or a negative current from west to east, that is, with the earth's motion.

It will naturally be asked why, if the fundamental conception of the proposed theory is so simple, was it not thought of before? The reason of this is, that it was not until it was experimentally proved in Prof. Helmholtz's laboratory in 1876, that a quantity of electricity in mechanical motion relatively to a magnet, deflected it, that attention would be turned to the consideration of the electromagnetic effects that must arise from the mere rotation, round an axis, of any body of any material having an electric charge. Or again, it might be objected that in the experiments described by Prof. Helmholtz, the magnet, which was deflected, was at rest while the electric charge was in motion, whereas, in the earth all parts are moving at the same rate, and, therefore, that the electric charge on the surface could not produce magnetism in the interior. The answer to this is, that all points in the earth are undoubtedly moving with the same *angular* velocity, but not with the same *linear* velocity; therefore, the various parts have relative motion one to the other, the amount and direction of which has been mathematically determined by the Authors in their paper; and the rather curious result has been arrived at, viz., that in the earth, the motion of *any* point on the surface *relatively* to any point inside, is always in a line perpendicular to the line joining the two points.

There seems, therefore, every reason for accepting the fundamental idea that if the earth be electrically charged, it must, from the very fact of its revolution, be magnetic; and the fact that Profs. Ayrton and Perry have proved, by close mathematical analysis, that if there be an iron shell thick or thin in the earth, that the distribution of magnetic intensity arising from their theory will be that known to exist from experiments, only adds additional weight to the theory.

One of the great difficulties in connection with terrestrial magnetism has been to explain the well-established connection between terrestrial magnetic disturbances and celestial phenomena, but now that terrestrial magnetism has been made to depend on the static electric charge on the earth's surface, we realise that any change in the dielectric between us and the sun must alter the electrostatic induction of the sun on the earth, therefore the static electric distribution on the earth's surface, and, consequently, terrestrial magnetism. Hence, since the sun and other members of the solar system may very likely have potentials so different from the earth that we can hardly conceive the amounts, we should expect that the earth's magnetic intensity would vary as do the ocean tides; and this is known to be the case. Again, it is also evident that, besides these regular changes, every time a great mass of vapour is suddenly formed and condensed on the earth, or whenever great changes are occurring in the solar

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atmosphere, whereby the lines of *electrostatic induction* from the sun to the earth are altered, we should find corresponding changes in terrestrial magnetism, such as we now know as magnetic storms. And not only this, but, as the planets are charged bodies, their motions relatively to the sun ought to cause motions in the sun's atmosphere, such that, for instance, the allineation of a number of planets and the sun, or the near approach of any planets to the sun, if the alligned or approached planets have potentials nearer that of the sun than many of the other bodies of the solar system, ought to diminish the storms in the solar envelope, and ought to alter the electrostatic distribution on the earth. But it has been ascertained from repeated observations that the near approach of a planet to the sun both affects the sun's spots and terrestrial magnetism.

CROSSLEY'S MODIFICATION OF THE HUGHES MICROPHONE.

By WALTER EMMOTT, Assoc. Soc. T.E.

No sooner was the telephone in the market than various attempts were made to adapt it to a wider sphere of usefulness than the act of simple conversation between two stations—for example, to the transmission of speech from a lecturer at some distance from the transmitter; but the instrument could not be made equal to the task; it was practically useless unless when spoken into, and the public speaker who would undertake to speak at such a mark was not to be found.

The discovery of the microphone by Professor Hughes, however, supplied the necessary auxiliary, as it was found that sounds made some distance from the microphone could be distinctly heard on the telephone, and Mr. Louis J. Crossley, of Dean Clough, Halifax, commenced to experiment with it in this direction.

Microphones of every conceivable form and material were made, and some very strange and unexpected results obtained; but, as a record of these experiments, which have been carried on for about ten months, would occupy too much space, we will only explain one form of microphone which has been found perfectly to answer Mr. Crossley's requirements, which were as follows:—

1. The instrument must be sufficiently sensitive to transmit clearly to a Bell's telephone at least three miles away every word spoken in a moderate tone of voice when the speaker stands some distance from, and not even facing, the instrument.

2. It must not be liable to get out of adjustment by a severe shake.

3. It must be capable of working by not more than two cells, and the sounds received in a telephone three miles away must be at least as loud, and the articulation as good, as when speaking closely into a very good telephone.

These requirements have been fulfilled most perfectly by an instrument arranged as per fig. 1, in which *a b c d* are four pencils of carbon loosely held in four carbon blocks *d e f g*, and connected in circuit with a battery and the primary wire of an induction coil as shown. The line is connected to one side of the secondary, the other side being to earth through the telephone.

This form of microphone is mounted upon a piece of wood (pine answers well) and is then covered with another thin piece of wood, which under certain circumstances gives better articulation.

As a means of thoroughly testing this form of microphone, it has been worked daily for some weeks past against a number of other microphones, over 18 busy telephone circuits, and has been found to give the best results; it not having failed even once.

As an addition to the telepone it is very valuable, almost any intensity of sound being attainable. An audience of 600 persons have heard distinctly (from a good telephone) words spoken upwards of half a mile away. The annoyance of speaking loudly into a telephone is also avoided as a whisper can be heard by means of the microphone.

The most interesting application of the instrument, however, has been the transmission of the services from a church in Halifax to a distance of three miles by wire every Sunday for some months past; in fact, it was for this purpose that the instrument was first designed, and it has worked well in this capacity although placed under most unfavourable circumstances, being stationed within a foot of the bottom of the pulpit and nearly behind the minister. This was the only available position to be had, as the instrument requires to be so fixed as not even to attract the attention of a stranger in the pulpit, much less the congregation. When this mode of assisting the chaplain in his capacity of preacher has become a recognised institution, we may hope to place our instruments at least a little more to the front.

On Sunday, April 13th, a wire was connected up by Mr. E. C. Warburton (Engineer and Superintendent of the Telegraph Department of the Lancashire and Yorkshire Railway), between his office in Victoria Station, Manchester, and the Square Church, Halifax, a distance of 36 miles. At Halifax it was joined on to the church wire, and a number of electricians and others interested in the science met at Mr. Warburton's office for the purpose of hearing the service from the church 36 miles away.

As the wire ran side by side with some 25 or 30 others at the Manchester end, there was a fair amount of induction, and the results were somewhat marred by this effect, and, especially, by the induction of a more than usually noisy Morse circuit, which came on at intervals with a bang. However, during the intervals of moderate quiet a large part of the sermon and even of the prayers were heard and reported.

The musical part of the service was beautifully rendered throughout, being audible over and above even our uproarious enemy; the fine tones of the organ and the singing being heard from a good telephone some yards away from the mouthpiece.

After the service, several experiments were made, from which it was agreed by all, that if the transmitter could have been placed opposite the speaker, every word would have been heard distinctly over and above any ordinary amount of induction.

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FIG. 2.

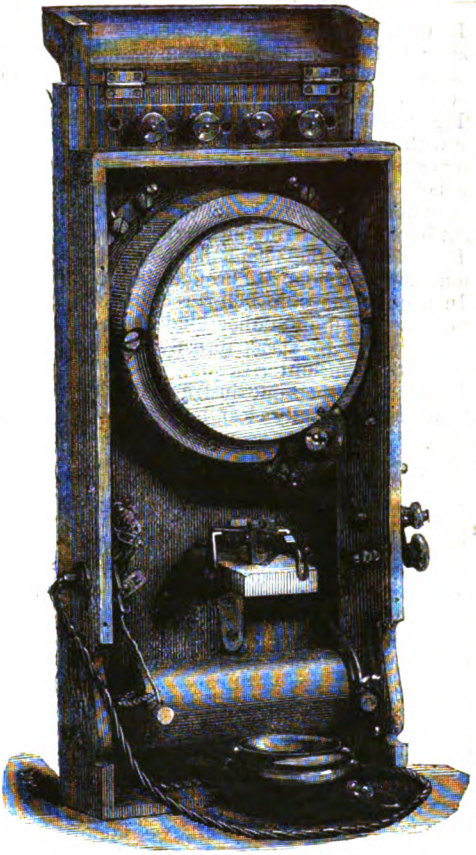

FIG. 3.

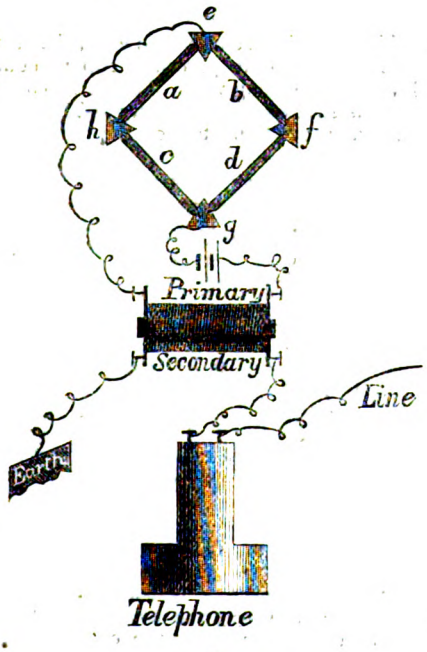

FIG. 1.

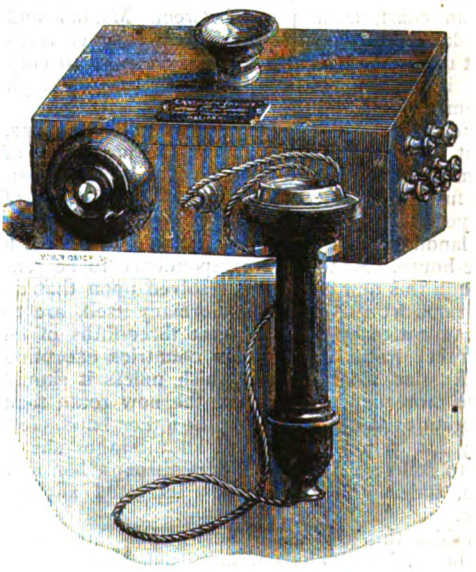

FIG. 4

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In the evening one of our private wires,* from Halifax to Bradford (a distance of 10 miles by wire), was joined to the church, and the whole of the service was distinctly heard and reported with ease.

Fig. 2 exhibits a complete form of instrument for use with the telephone. When the telephone is in the position shewn, the line is switched direct on to the bell, the battery being disconnected from the microphone and switched on to the key seen at the right-hand side, for ringing up the distant station.

By lifting up the telephone to speak, the microphone and telephone are brought into circuit.

In a quiet office no bell is required, as it is only necessary to call out rather loudly to be heard, nor is it necessary to speak directly into the mouthpiece of the transmitter.

Fig. 3 shews the same instrument with the front off, and is sufficiently clear to explain itself. The induction coil will be seen below, as also the hook on which the telephone hangs, while the microphone is fixed in the wooden chamber above.

Fig. 4 shews another and cheaper form of instrument.

The Bell telephone is shewn in connection with these instruments, though Mr. Crossley has succeeded in producing an independent receiver for his instrument, but has not yet been able to reduce it to so neat and handy a form as that of Bell's instrument, although he expects shortly to accomplish this also.

THE NEW GERMAN-NORWEGIAN CABLE.

AT a recent conference held in Christiania, it was agreed between the representatives of the German Empire and the two Governments of Norway and Sweden, that Germany shall, at her own cost, lay down a three-wired cable from Romoe, an island off the west coast of the Schleswig and the Norwegian coast, at a point between Mandal and Arendal. From that place the Norwegian Government undertakes to carry the line on so as to connect it with the whole Scandinavian telegraph system.

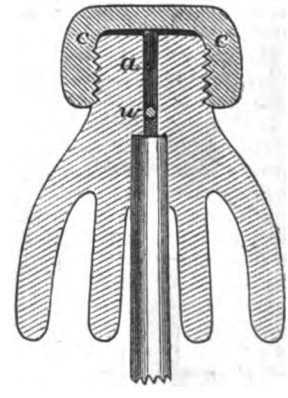
The cable is estimated to cost two million crowns, about £95,000, and it remains in the possession of Germany who has also to repair it at her own cost. It is further specified to be laid by October 1st of this year. Norway is to put up a new wire from the landing point to the capital, together with a cable-house. As to the correspondence to be sent through this new cable, it is resolved upon that all telegrams from Norway to Germany itself, are to be transmitted by it, and at least three-fifths of all the other traffic with foreign countries, excepting the Russian, English and Danish, unless it should prove more expensive to use the new route than the other existing ones. On the other hand, Germany has power to forward all messages she is able to collect and forward them through her new cable, unless the sender has indicated another route.

Besides this new cable Norway has three ways for her telgraphic communication abroad, viz., through Sweden and by cable from Trelleborg to Rügen, from Arendal to Fredericia in Denmark (cable to Hirtshals), and from Ekersund to Peterhead in Scotland, this last being reserved for her English traffic. If the new line is slower than the existing ones, Norway has a right to forward her telegrams by the best route. Besides, Norway may become free to forward her telegrams by any way she choses by purchasing one-half of the cable, or by giving notice to the convention at the end of 20 years. Norway has a very large correspondence with all sea-faring countries because of her extensive mercantile navy, and it is said that the correspondence of Germany with Norway is second only to her correspondence with England.

Hitherto Germany has been obliged to send her telegrams to Norway through Denmark and Sweden, a course which has been manifestly irksome to her, owing perhaps in part to the uneasy political relations between her and the Danes. In 1878 she tried to effect an arrangement similar to that which has just been concluded, but Norway refused because of the great expense which she was then asked to share. The new scheme will, of course, deprive Denmark of the traffic which formerly passed over her lines between Germany and Norway; and, seeing that the present means are ample for the necessities, the Danes are disposed to regard the new act of the German Government as proceeding from a desire to have a line of their own, in case of war between Germany and their own country. This idea was also expressed in the Norwegian Storthing or Parliament, when the Government asked for the money for the new line.

CREIGHTON'S IMPROVED INSULATOR.

THE object of this insulator is to effect the securing of the line wire to the porcelain cup without the employment of binding wire. The method by which this end is effected t is as follows :—The wire *w* is placed in a groove in he top of the insulator, and



then an ebonite piece *a* is added, and finally a porcelain cup *c* is screwed over the head of the insulator; this presses down the ebonite firmly on the wire and jambs it tight in the groove. In order to effect this object more thoroughly, the lower part of the groove is curved, as shown, so that the line

* Blakey Bros. and Emmott.

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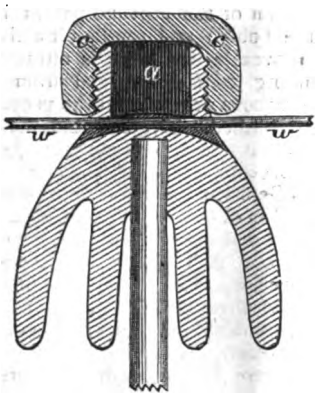
wire only bears on a small surface, whilst the piece of ebonite being slightly hollowed on its under surface has a tendency, when firmly pressed down by the cup, to slightly bend the wire over the curved portion of the groove, and thereby to give the wire a tighter grip. In addition to the care



with which the wire can be thus secured, this method possesses advantages as regards insulating properties, for the wire being only in contact at a few points with the porcelain has practically a greatly diminished amount of leakage as compared with wires secured by wire bound completely round the insulator.

LONTIN'S ELECTRIC LIGHT

WE are indebted for the following account of M. Lontin's system of electric lighting, which has been on view all the winter at the Gaiety Theatre, Strand, to the Count du Moncel's excellent new treatise *L'eclairage Electrique* (Hachette & Company):—

In the Lontin machine for apportioning the electric light, we have a means not only of dividing the light, but of distributing it among several jets to any convenient intensity, while making some of these profit by the feebleness of the rest.

In principle the machine consists of a series of electro-magnets fixed in the inside of an iron crown arranged vertically, and in the centre of which rotates an electro-magnetic system composed of as many magnetic cones as there are electro-magnets on the crown. The fig. represents this machine, in which the moveable interior electro-magnetic system represents the *inductor*, and the fixed exterior system the *induced* coils.

The inducting system is composed of an iron cylinder upon which are riveted a number of iron plates resembling the teeth of a pinion, on which are round wire helices A A connected up for tension. In order that the spires of these helices do not shift under the influence of centrifugal force and expansion by heating, the iron plates forming the cores are made thicker at their free ends than at their junction with the axle, and hence serve for retaining washers to the coils. Horizontal cross-pieces mounted on two bronze wheels, and against which they abut, otherwise maintain them in their position. In fine, the winding of these helices is so contrived as to reverse the polarity of alternate plates, so that the movement of the drums successively brings a different magnetic pole in front of the iron cores of the induced system, which is thus polarised alternately.

The inducting system is kept magnetised by the dynamo-electric generator which we have above described,* and which may be mounted or not on the same axis. A battery or another machine may be substituted for this generator, but the latter is more economical.

The induced system consists, as we have seen, of a great ring of iron *b b*, immovable, and furnished inside with a series of iron plates fixed across the field, like the teeth of a wheel gearing internally and wound with magnetic helices B B B. These helices are connected together in pairs so as to form a complete magnetic system, and their free ends come to the commutator M, which permits the currents to be gathered either separately or collectively, by means of rubbers *a s*. In the interior of this ring turns the inductor which is so disposed that the magnetic cores of the two systems pass each other without touching. Thus each induced core is magnetised alternately, for if one of the inducing cores has North polarity, the neighbouring induced core will have South polarity, which will produce a corresponding current in the coil. When the inductor has advanced, the magnetism that it had determined in that induced core will be reversed, since the polarity of the next inducing core is contrary to that which went before, and the result will be a reversed current in the coil. As this action repeats itself simultaneously over the whole system of induced electro-magnets, each of these will be able to furnish its own alternate current. Admitting that each induced system of two coils is capable of feeding one electric lamp, the machine figured will supply twelve lights, and, if we wish to obtain these of different intensities, it suffices, by means of the commutator M, to join the coils so as to get greater or less strength of current.

The commutator M is arranged to react upon as many of the contact plates as there are utilisable currents. The number of these currents depends upon the construction of the machine, and we have seen that the machine illustrated gives twelve. There are, therefore, 12 contact-plates, and to each of these there are two corresponding terminals; one connected to the contact itself, the other to a hand key I. The first receives the wire of the corresponding magnetic system, the second the wire which runs to the electric lamp. Besides this, the different contacts are themselves provided with hand keys, which connect them two and two and permit of instantly joining or separating the partial current.

This machine has been applied during some time to the lighting of the *Gare de Lyon*, where it furnishes 31 lights from a single generator and two induced systems of 24 bobbins each. In joining together these coils, and interposing in each of their circuits several Lontin regulators, M. Lontin has been able to get these 31 lights, each of which is equivalent to 40 Carcel burners.

For six months these machines have also been

* This consists of an axle from which project four circles of iron spokes wound with coils connected together in two separate circuits round the axle and to the commutator after the manner of Gramme's ring. These are revolved between two upright flat electro-magnets fed on the accumulation principle.

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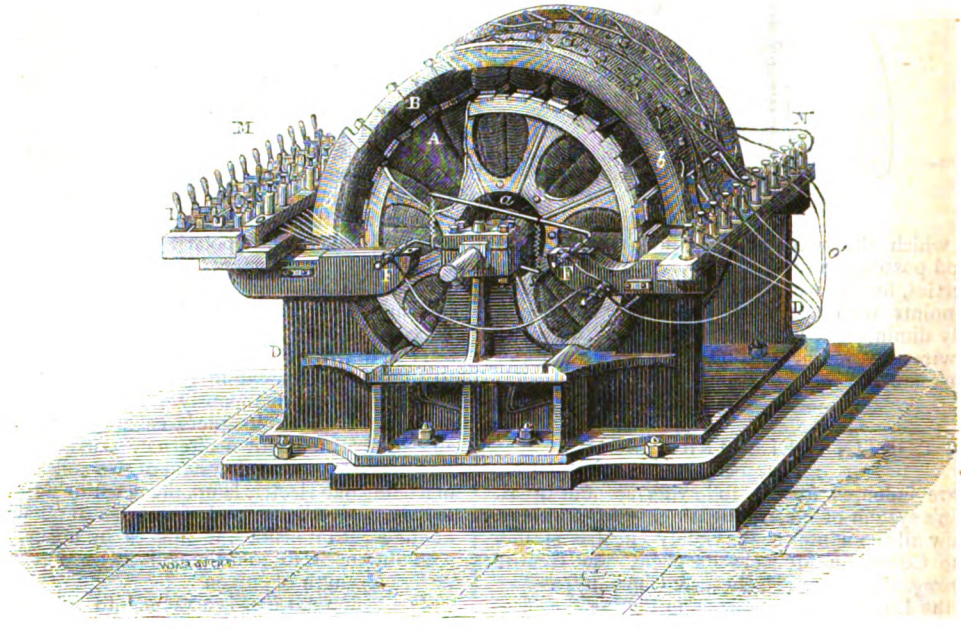
installed at the *Gare St. Lazare*, where they light 12 lamps, two of which, situated at the entrance to the station, are 700 metres from the machine, a fact which refutes the assertions which have been made to the effect that alternating currents would not produce light beyond 200 metres.

We extract from a published description of the Lontin machines, the following account of the Lontin Lamp :—"The first and chief advantage of these regulators is that the moving and regulating parts are so constructed that the lamp can operate in all positions—upright, horizontal, and even inverted, without stopping. The novel application which has been made in these regulators of a metal wire, which acts by the heating due to the passage of the current, and maintains the arc rigorously constant, permits of the suppression of electro-magnets (whose resistance interposed in the circuit, caused a notable increase in the expense of the electricity), and allows of a more regular light.

"The approach of the carbons in proportion to their waste, is obtained by applications not less happy, namely, the employment of a derived current taken from the lighting current itself. In the apparatus there is fixed a solenoid, formed of a bobbin wound with fine wire, offering a high resistance to the current. This bobbin encloses a moveable core of soft iron, which, when passive, arrests the motor mechanism of the carbons. Whilst the arc keeps its proper width, all the current passes by the carbons, because of the great resistance it encounters in the bobbin ; but, when the arc increases, a small portion of the current passes by the fine wire of the bobbin and renders it active. In this case the moveable iron core is attracted, and the motor, finding itself disengaged from its detent, brings the carbons nearer until the proper length of arc is re-established. The solenoid then ceases to act, and the iron core arrests the motor again. This motor, having only to move the carbons, is very simple in construction."



This use of a derived circuit can be equally applied with advantage to all regulators which produce of themselves the gap between the carbons, and renders their action sure and regular, whatever the variations of the current. This system has also been applied with success to the regulators of M. Serrin installed at the *Gare St Lazare*, the Paris terminus of the *Chemin de Fer de l'Ouest*. We may add to the Count du Moncel's above account, that these machines are made in England, by Messrs. Latimer Clark, Muirhead & Co., of Westminster.

LUGO'S ELECTRODES FOR ELECTRIC LIGHT.

THE improvement here illustrated is one of the latest of its class, having been patented as recently as September last (by Orazio Lugo, of Flushing, N.Y.). The engraving represents but two of several modifications, all of which include, as a leading feature, the introduction of air or other fluid into the electric arc in order to keep the electrodes cool and retard their consumption. They are made of the usual carbon, or any suitable material. The invention consists in either making the electrodes tubular, or in combining each of them with a tube which is wholly or partially surrounded by the carbon or other material of which the electrode is composed, for the purpose of affording a channel through which air or other fluids may

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be conducted, and may be discharged from the points of the electrodes into the electric arc. In the practice of the invention the tubular electrodes may be open at both ends, and reliance had upon the natural draft for creating a current of air through them; or they may be connected with pipes, through which air or any desired fluid or fluids is forced from a distant locality into and through the electrodes with any given pressure. The inventor

states that he preferably incases the tubular carbon electrodes in a metallic shell, for facilitating their electrical connection with the plus and minus wires of an electric circuit, supplied with a current from a battery or other source of electricity. Further, instead of arranging them vertically, in direct line with each other, it is preferred to have them side by side, with their upper ends inclined towards each other.—*Useful Arts.*

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

To the Editor of THE TELEGRAPHIC JOURNAL.

Permit me to criticise some of the statements and correct a few errors in your Review of my recent work on the "Speaking Telephone, Electric Light, and other recent Electrical Inventions," published in your issue of the 15th ultimo.

1. In writing the above-mentioned book, the object which I had in view was not "to advertise Mr Gray's claim to be recognised as the first and true inventor of the speaking telephone, nor to support the claim of Mr. Edison to the discovery of the microphone; but to present without favour or prejudice, all attainable facts relating to the electrical transmission and reproduction of sounds, and let the reader judge for himself just what measure of credit is due to each of the different explorers in this wonderful field of discovery.

To this end I have published all attainable records bearing upon the subject, including those of the four principal inventors, Gray, Edison, Bell, and Dolbear, without alteration or omission.

2. You say, "Mr. Gray was probably the first to conceive of a theoretically correct speaking telephone; but to Bell belongs the honour of achieving one. More than this, Bell did not simply succeed, where Gray failed, by adding some happy improvement to Gray's plan."

How could Mr. Gray's telephone fail if it was "theoretically correct?" If a theoretical device could not be made successful in practice, would it not necessarily indicate that the theory was incorrect? But Gray's telephone was not a failure, and instruments constructed in exact accordance with his original drawings and specifications, are good articulating telephones. Moreover, Mr. Gray's method of producing articulate speech by varying the resistance of a battery current is much more effective than that of Professor Bell subsequently invented, which depends upon magneto-induction currents generated by the action of the voice, as is fully proved by the great superiority of Edison's carbon telephone, which is based upon this principle.

3. Your statement that "Bell's telephone is entirely 'electro-magnetic,' (magneto-electric?) while Gray employs a battery," is misleading, as implying that Bell never used a battery with his method. Bell used a a battery, as he says, until "it was proved that the only use of the battery was to magnetise the iron core of the magnet," for the effects were equally audible when the battery was omitted, and a rod of magnetised steel substituted for the iron core of the magnet.* Regarding the change from the electro-magnetic to the magneto-electric method, Professor Bell says that, "Professor Dolbear, of Tuft's College, not only claims to have discovered the magneto-electric telephone, but I understand charges me with having obtained the idea from him through the medium of a mutual friend."

4. How do you know that "it was an *accident* that Bell's transmitter happened to be like Gray's earlier receiver?" or that "had the latter never existed at all, Mr. Bell would still have arrived *naturally* at that form?" Supposing this to be true, however, could not the same observation be made with equal propriety in regard to any other invention or discovery?

For example, could you not say, "it was an *accident* that Vespucci's more successful discovery happened to be like Columbus's earlier one. Had the latter never existed at all, Vespucci would still have arrived *naturally* at the discovery of America!"

5. How can Bell's be "a *totally different* instrument from Gray's," when they both use the same receiver? I have nowhere asserted that Professor Bell's telephone was *identical* with Mr. Gray's. On the contrary, I have stated distinctly that "in 1876, Bell invented an *improvement* in the apparatus for the transmission and reproduction of articulate speech, in which magneto-

* See *Researches in Electric Telephony*, by Professor Alexander Graham Bell, Journal of the Society of Telegraph Engineers, Vol. VI, No. 20, p. 406—410.

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electric currents were superposed upon a voltaic circuit."

It no more detracts from Professor Bell's achievement that he employs a portion of Mr. Gray's invention to produce the *magneto telephone*, than it does from Mr. Edison that he employs a portion of Mr. Gray's invention to produce his *improved carbon telephone*—the same receiver being employed in all.

6. In the accounts which have been published of experiments with the microphone, the statement has frequently been made, that minute sounds are actually magnified by it, in the same sense that minute objects are magnified by the microscope. A little reflection will show, however, that there is no real analogy in the action of the two instruments. The sound that is heard in the receiving instrument of the microphone, when a fly is walking across the board on which the transmitter is placed, is not the sound of the fly's footsteps, any more than the stroke of a powerful electric bell, or sounder, is the magnified sound of the operator's fingers tapping lightly and, it may be, inaudibly, upon the key. This view of the subject readily explains why the microphone has failed to realise the expectations of many persons, who, upon its first exhibition, enthusiastically announced that by its aid we should be able to hear many sounds in nature which had hitherto remained wholly inaudible.

Referring to this idea that, faint sounds are not *augmented* by the microphone, you say that "this shows too well that Mr. Prescott does not know what a microphone is, and has never heard one. If Mr. Prescott has not himself heard minute sounds *transmitted* to a distance by a real microphone, why does he also disbelieve all the high authorities in this country who have?"

Is it possible that a reviewer who sets himself up to criticise the style and grammar of a book, as well as the accuracy of its statements, is unable to recognise the difference between *augmented* and *transmitted*?

Suppose that an apparatus could be so delicately arranged that the tread of a fly could be made to close an electric circuit and explode a powder magazine, would you contend that the force of the explosion was due to the *augmentation* of the power of the fly?

Permit me to close this brief notice of your review by quoting from its concluding paragraph. "It is a strange method this of writing a scientific review. Let us hope it is not common in England."

GEORGE B. PRESCOTT.

[While thanking him for his courtesy, I briefly respond to the above remarks of Mr. Prescott, under the heads he has adopted:—

2. Mr. Prescott knows as well as I do that correct mental conceptions are often difficult to realise from the imperfect materials obtainable and the practical inconvenience of the resultant form. In the case of Gray's telephone, for example, electrolysis of the liquid must hamper the theoretical action of the instrument, while batteries are inconvenient in private homes. If Mr. Gray's instrument is a truly practical success, why is it not in common use? Edison's carbon telephone is better than Gray's, but it is questionable if it is more effective than Bell's, for what it gains in loudness it lacks in definition.

3. Answers itself: the electro-magnetic telephone of Bell is also magneto-electric.

4. A study of Professor Bell's account of his researches show that he was naturally led step by step to a diaphragm. The example of Columbus and Vespucci is not apt since Vespucci followed Columbus, whereas Bell was working independently and simultaneously with Gray at the same problem. Had Vespucci sailed east and arrived at America, while Columbus sailed west, only reached the Indies, the parallel would have been better.

5. The principle of action in the two instruments is different.

6. Here again your analogy is somewhat faulty. The bell you introduce is an independent source of sound struck *mechanically* by means of the current, and would disguise any sound, just as a call-bell would disguise a telephone speech. In the microphone the *currents directly produce the vibrations of sound*, whereas in your example they only liberate a hammer which smites a distinct sounding body into its characteristic state of vibration. The sound vibrations acting on the microphone transmitter liberate corresponding pulses of current, which control the vibrations of the telephone, and cause it to imitate the original sound. You will admit, I suppose, that it is therefore legitimate to say that *audible* sound vibrations transmitted by microphone are *heard* in the telephone. How then can you say that vibrations *below the range of the ear* are not heard also?

Although *augment* is rather a vague word, I suppose I was right in taking you to mean *magnified*, or made audible.

With regard to your first and last observations, I may say that I was not singular in judging your book to be written for the purposes I stated; and so long as there seems to be some danger of mere money interest doing injustice to science, and violence to the rights of inventors, so long as any American writer appears to ignore European work and write as if only America existed, so long I trust will such reviews be written in England.—*The Reviewer.*]

THE DOMESTIC TELEGRAPH COMPANY.

SIR,—I have followed the recent controversy relative to the origination of variable carbon resistances, with much interest, and especially so, as I have been using for some time a carbon resistance tube which gives very satisfactory results, but of which, as yet, I have seen no description. I take a glass tube filled with very finely powdered graphite. In the cork which closes one end of the tube, I insert a small brass nail, which remains immovable, and is connected with the line wire. Through the cork in the other end I place a straight piece of wire so arranged that it can be pushed backwards and forwards, thereby increasing and lessening the distance through the powder between the ends of the metallic conductors, thus enabling me to vary the resistance of the line at will. By this method very delicate changes of resistance can be easily produced, as well as greater, the only limit to which is the length of the tube. I have also found these rheostats to be very constant and reliable, and believe they can be used satisfactorily where a pressure resistance would fail.

145, Broadway, New York, April 3, 1879. WM. HADDEN.

NEW METHOD OF SYNCHRONISING CLOCKS.

DEAR SIR,—Kindly correct a misstatement in your "Notes" of the 15th inst., where under the head of "Synchronous Clocks" you say that "we understand that it"—*i.e.*, some plan by Messrs. J. Edmundson and Co., "has been recently applied to the clock of St. James's, Piccadilly."

That clock is not made "sychronous" by any system, which would at best be wanting in any means for picking up automatically any possible error of the non-transmission of currents, but is "synchronised" on our Metropolitan system of Greenwich mean-time wires;

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and on a plan, a modification of our original patent, the invention of Mr. George Lund, of Messrs. Lund and Blockley, our West End concessionnaires, by which not only is every minute error hourly corrected, but so accurately that the first blow of every hour, day and night, marks absolute Greenwich mean-time time to a second.

The insertion of the above will much oblige.

Yours very truly,

41, Cornhill, London, BARRAUD & LUND.
April, 18, 1879.

CLERAC'S TUBE.

SIR,—With reference to your note to Mr. Edison's letter in your impression of 15th inst., I beg to inform you that you are in error in supposing that "these new powers of the carbon telephone have been discovered since Professor Hughes published his researches on the microphone."

So far from this being the fact, I am in a position to assert that the date of my arrival in England with the carbon transmitter in its present form, antidates by two months the publication of Professor Hughes' researches at the Royal Society.

Apart from this fact, Mr. Edison and myself were aware for two years previously of the mircrophonic capabilities of the carbon transmitter, and it was in the endeavour to eliminate these characteristics from the instrument that so much time was consumed.

Yours truly,

JAMES ADAMS,
Assistant to T. A. Edison.

45, Avenue de l'Opera, Paris,
April 24th, 1879.

[Although the controversy on Clerac's Tube is practically closed, we give space to Mr. Adams' letter. It is a pity that these alleged microphonic effects, if really such, were not published until after the discovery of the microphone by Professor Hughes. Without stickling for this point of publicity, however, and for the sake of argument, admitting that the difficulties Mr. Edison encountered, in perfecting his carbon telephone, were microphonic ones, it appears to us that that fact only proves that Mr. Edison failed to see the great importance of the pertubations he wished to get rid of, and therefore missed, perhaps narrowly, the discovery of the microphonic principle. No unbiassed person can for a moment believe that so "smart" a man as Mr. Edison would have discarded a comprehensive discovery like the microphone, which in itself is far more marvellous and prolific than the carbon telephone, and, indeed, is found to include the latter, and to explain its action. It is evidently forgotten by Mr. Adams that the discovery of Professor Hughes is a property appertaining to contact under pressure between *any conductors soever*, carbon contacts simply being one instance. Had Professor Hughes begun his researches from the Edisonian stand-point, that is with carbon, he would probably never have discovered the general microphonic principle at all. It would be futile to say more on this subject.—ED. TEL. JOUR.]

Notes.

THE ELECTRIC LIGHT.—*La Lumiere Electrique* is the title of a new periodical which has just been started in Paris, under the scientific direction of the distinguished Count du Moncel. The first number is comprehensive and well illustrated, and promises well for its success. We welcome its appearance as a sign of the permanency of electric lighting.

Two electric lamps are to be fitted up in light-houses off Marseilles and the mouth of the Gironde.

DR. LYON PLAYFAIR has been elected Chairman of the Select Committee appointed to consider the subject of lighting by electricity. Scientific witnesses from all parts of the country will be summoned to give evidence. Dr. Tyndall has been already examined.

THE Albert Hall exhibition of electric lighting apparatus will be opened with a lecture by Mr. W. H. Preece, on Wednesday, May 7, and remain open until the end of the week. There will be some novelties shown.

WE hear that Werdermann's system of electric lighting has been bought by a Parisian company.

A TELEPHONE concert has been held between Terre Haute and Indianapolis, the singers being two miles apart, and the audience seventy-three miles distant. The Edison transmitter was used.

AT the Society of Telegraph Engineers' meeting, on April 23rd, Major Webber announced a new American carbon telephone, with a diaphragm of animal tissue, which gives excellent results over 70 miles of wire.

LAMBRIGOT'S TOY PHONOGRAPH.—An interesting toy phonograph, which has been contrived by M. Lambrigot, a French engineer, was exhibited by M. Hospitallier at the meeting of the Society of Telegraph Engineers on March 23. The phonogram, or vocal record, is composed of a set of parallel lead wires, with the vibrations indented along the upper surface. Speech is obtained from these by drawing the edge of a cardboard disc along them, and listening into a conical cardboard ear-piece, which is connected at its apex to the centre of the disc by a leaden wire. The phonogram is made by first impressing the speech to be registered in a mould of warmed stearine by means of a phonographic diaphragm and stylus, then getting copper electrotype of this stearine mould. Soft lead wires, pressed into this hard copper mould, give a casting of the record on the surface of the wires. These wires, with their vocal corrugations, are then arranged in parallel sets upon a board. In this way familiar sayings and mottoes may be engraved, and we fancy that some amusement might be afforded at merry makings by this simple contrivance.

LONDON FIRE TELEGRAPHS.—It is rumoured that the Exchange Telegraph Company have received orders to erect fire telegraphs in certain of the London streets.

AT a recent masquerade ball in San Francisco, a prize for the most original costume was carried off by a gentleman who was dressed as a telegraph post, twelve feet high, with a fire alarm box behind. We have much pleasure in recommending this fancy garb to the members of the Metropolitan Board of Works. Now that they have at last consented to admit fire alarm telegraphs into London, they ought to wear it with a degree of swagger and pride.

MR. APPLEGARTH, who first introduced to London the Jablochkoff, and afterwards the Rapieff electric light, is now again to the front with a new system, viz.: one in which a thermo-pile is used, and which bears the name of its inventor, Mons. E. Sudre.

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THE French Government have awarded gold medals to Messrs. John E. Smythe, Horatio Pritchard, W. Leigh, and H. S. Perry, *employés* of the Submarine Telegraph Company, for their gallant assistance in rescuing the crew of the French lugger *l'Ange*, wrecked on the Cornish coast on the 1st of February last.

MR. JOHN CROSSLEY, of Halifax, the eminent manufacturer and philanthropist, died at Broomfield on April 16th.

WEATHER TELEGRAMS.—Any person may now ascertain by telegraph the actual state of the weather in any district of the United Kingdom, by wiring the Meteorological Office, London, and paying 1s., in addition to the 2s. for the message and reply. Forecasts of the prospective weather for the next 24 hours are also issued three times a day, for all parts, except the Atlantic sea-board, for which the office will only issue reports of the existing weather.

THE use of telegraph wires for messages throughout Paris will cease after May 1; M. Bontemp's system of pneumatic tubes being almost complete. Blank forms for messages will then be sold to the public, and may contain any number of words, the originals being forwarded to their destination. There will be two kinds of forms, one for open and one for closed messages, priced respectively, 50 and 75 cents.

M. VIOLLET LE DUC, the famous French architect, has submitted to the Municipality of Paris, a scheme for receiving uniform time in that city, which is likely to be adopted. Twelve centres will be established at *Mairies* and churches, from which branch wires will run to fourteen other public buildings. The twelve centres will be connected to a Standard clock at the Observatory. The cost of installation is estimated at 80,000 francs, and the management will be entrusted to the Telegraph Department, the annual expense being 7,500 francs.

THE French military authorities have been making extensive experiments at Mont Valérien with the electric light as a means of signalling, and exploring a country by night. Portable Gramme machines supply the current, and reflectors are used to direct the beams to any point of the landscape. It is believed that visual signals could be exchanged between Paris and Orleans, were the apparatus sufficiently elevated.

TELEGRAPHY IN THE GULF OF ST. LAWRENCE.—We have received from the Boards of Trade of Montreal and Quebec the Report of the Select Committee, appointed by the House of Commons of Canada, in 1876, to enquire into the possibility of establishing a system of telegraphy in the waters, coasts, and islands of the Gulf of St. Lawrence, in connection with the shipping, fisheries, and signal service of Canada. The Gulf of St. Lawrence is at present dangerous to navigation, no less than fifty wrecks having taken place on the Island of Anticosti, which bars its entrance, during the last ten years. The ice of the river, and the frequent fogs, render it hazardous for ships, especially in spring and early winter. It is therefore proposed to connect the light-houses by cables and land lines to the existing telegraphic system of the country, and to locate a powerful steamer at some central point, such as Cape Gaspé, at the northern lip of the Gulf, which can render assistance when called for by wire. Semaphores would also be erected at convenient points, to communicate with light-houses. The committee have recommended a detailed scheme, which would take a year or two to complete, and cost over 370,000 dollars. This scheme includes cable from Anticosti to the north shore of the river, from Magdalen Islands to Cape Breton, from Bird Rocks to Magdalen Islands, from St. Paul's Island to Cape Breton, and a number of land-lines, including one from Murray Bay to Mingan, 385 miles in length, one from St. Lawrence Bay to Beddeck C. Breton, 75 miles, one in Anticosti from West Point to Fox Bay, of 145 miles, and one along the north coast of St. Lawrence from Moisee to Mingan, of 100 miles. The completion of such a scheme would greatly benefit the commerce of the St. Lawrence, as well as the valuable fisheries of New Foundland, since, in the one case, insurance rates would decrease, and, in the other, the cod fishers would be able to pounce upon their prey, as the Norwegian herring fishers now do, by help of the telegraph. It is to be hoped that the Canadian Parliament will sanction this wise proceeding.

THE *Boston Post* is responsible for a report that a new invention, destined to revolutionise telegraphy, has been tried between Paris and New York at a minimum speed of 200 words per minute, and is capable of sending an entire number of the *Times* to America in *half an hour!* It is further stated, that the Anglo-American Telegraph Company offered the proprietors of this instrument £400,000 for it. If all tales are true, this is "nae lee."

COWPER'S TELEGRAPHIC PEN.—We learn from the *Journal of the Telegraph* that Professor A. E. Dolbear claims to have forestalled Mr. E. A. Cowper in devising a "writing telegraph," the same as his, with the exception that the Dolbear's receiving pen is worked by two arms, moved by the axial magnetism of two helices, instead of by galvanometer needles. The general principle of Dolbear's apparatus is said to be given in Prescott's work on the "Telephone," at page 260. We have read the passage in question, and find that it briefly describes a different arrangement altogether. In fact, it proposes to construct a telegraph in which the movement of the writing pen should thrust into or withdraw a permanent magnet from a hollow bobbin. The magneto-electric currents thus generated were intended, by a reverse action at the sending station, to move a duplicate pen. Mr. Dolbear states that he found the action of the latter pen less feeble than he expected, and abandoned the project. No one can reasonably put forward this futile idea as differing "only in a few minor particulars" from Cowper's invention, in which every element is different, and only the *object* is the same. As well call Edison's telephone the same as Bell's. As for the object of the instrument, that was conceived long ago by a Frenchman, whose plan is described in Du Moncel's earlier treatise.

THE telephone is being experimentally tried as a means of communication between the various police stations in the borough of Salford. It is found that communication can be carried on between the two stations with far greater expedition and distinctness than by the ordinary telegraph system.

A NEW telegraph company (says the American *Operator*) has just been organised in New York, with a capital of three million dollars. They propose to run lines between Boston, New York, Philadelphia, Baltimore, Washington, Chicago, and St. Louis. Compound steel-copper wire is to be used, and large poles. The President is ex-Mayor Edwin Reed, of

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Bath, Me. The organisation is designed to keep the company from falling under the control of "monopolists." It hopes to transmit 1,000 words per minute over its compound wires, and 500 over the ordinary ones now in use.

A NEW working contract has been signed between the W. Union Telegraph Company, and the New York, Lake Erie, and Western Railroad Company, for the telegraph lines of the latter.

EDISON'S INDUCTION DEVICES.—We have received from Mr. Edison, a copy of his United States Patent for "Circuits for Acoustic or Telephonic Telegraphs," No. 203,019, dated April 30, 1878. It describes several modes of compensating for the induction of neighbouring working circuits on a telephone line, by means of coils, electro-magnets, and condensers. Inasmuch as these are always permanently connected in circuit, his method differs from that of Professor Hughes, we have described in recent numbers. Professor Hughes reverses the ends of the compensating coils in the circuit by the signalling key itself in the act of signalling; his method not being specially designed for the protection of a telephone line, but of each ordinay circuit against all the others. Mr. Edison, however, does not confine his plans to telephone circuits. Another point of distinction between his methods and that of Professor Hughes, is the formation of the induction compensator itself. Professor Hughes arranges his coils with respect to their position, distance from each other, and length of wire, so as to imitate the actual disposition of the line wires. We cannot see that Mr. Edison has arrived at this idea. His specification, however, covers a good deal of Professor Hughes' preliminary work.

MOST people would say that there is little poetry in a telegraph post: nevertheless, Thoreau, the nature-poet of America found a great deal of the genuine frenzy in it. "What a receipt for preserving wood," he cries, "to fill its pores with music! How this wild tree from the forest, stripped of its bark and set up here, rejoices to transmit this music! When no melody proceeds from the wire I hear the hum within the entrails of the wood, the oracular tree, rejoicing, accumulating the prophetic fury. The resounding wood, how much the ancients would have made of it! To have had a harp on so great a scale, girdling the very earth, and played as by the winds of every latitude and longitude, and that harp were (so to speak) the manifest blessing of heaven on a work of man. Shall we not now add a tenth muse to those immortal nine, and consider that this invention was most divinely honoured and distinguished, upon which the muse has condescended to smile—this magic medium of communication to mankind?"

LARTIGUE'S MERCURY COMMUTATOR.—This ingenious contrivance, as described by *Engineering*, consists of a water-tight box made of insulating material, such as glass, porcelain, ebonite, or gutta-percha, and contains a quantity of mercury which, according to the position of the box, makes or breaks the contact between platinum electrodes whose position is determined according to the requirements of the case. The box may be divided into two or more cells of different sizes, insulated from each other, or communicating by orifices cut in the partitions. By this means the duration of the closed circuits may be regulated by the time taken by the mercury in passing from one cell to another. The commutator can be used in water or under conditions in which the ordinary keys would fail. In France the Northern Railway Company have adopted it as a water level indicator for tanks, an automatic pedal alarm for approaching trains, and an indicator for way points worked at a distance. It is well adapted for rough out-door work.

CONTACT ELECTRICITY.—Prior to the experiments of Professors Ayrton and Perry in 1876 all attempts to measure the difference of potentials generated by the mere contact of a solid and a liquid or two liquids with each other were more or less inaccurate. For example, Kohlrausch instead of using pure liquid surfaces, employed blotting paper moistened with the two liquids to be tested. These investigators have, however, designed an apparatus which measures the electro-motive force generated by contact of two liquid surfaces. It has usually been thought that the electro-motive force was almost inappreciable compared with that obtained from contact of metals in contact, but they find that strong sulphuric acid in contact with distilled water, solutions of alum, copper sulphate, and zinc sulphate has a measured difference of potentials of 1·3 to 1·7 volts, which, according to them, is more than twice as high as that of zinc and copper in contact.

MODIFICATIONS OF AMPERE'S LAWS.—Max Margules has communicated to the Vienna Academy the results of his researches upon "The Theory and Application of Electro-Magnetic Rotation," which he embodies in the two following laws:—1. If a pole of a magnet rotates in the neighbourhood of an unclosed conductor, about an axis which is within the magnet, a current will be induced within the conductor; but if a rectilineal conductor is turned about its own axis, in the neighbourhood of a magnetic pole, no current will be produced in it. 2. The rotation of a magnetic pole around a rectilineal conductor induces no current, but the rotation of the conductor about the pole produces an induced current. The first portion of the first law is a simple inversion of Ampere's statement of the law of electro-magnetic rotation; it has also been demonstrated by F. E. Naumann, and adopted as a fundamental law of the phenomena of uni-polar induction. But W. Weber, who first specially investigated the phenomena to which Faraday invited attention, disputes the sufficiency of Ampere's explanation of the rotation of a magnet on its own axis when it is traversed by a galvanic current.—*Ann. der Phys. und. Chem.*

AN AUTOMATIC CURRENT REGULATOR.—This apparatus, the invention of M. Hospitalier, and presented to the French Academy of Sciences by M. Du Moncel, consists of a resistance coil of a single layer of turns of which the wire is bared for a space of about a centimetre wide. A slightly convex lever, which forms a sliding contact is applied to the bare part of the wire. This contact is connected at one of its extremities to an armature placed in front of an electro-magnet, in which circulates the current which is meant to be regulated. An antagonistic spring withholds the lever at its other extremity. The circuit is formed by the resistance coil, the lever, and the electro-magnet. The apparatus being regulated for a given intensity, the sliding contact introduces into the circuit a certain number of the turns of the coil. If the current increases the electro-magnet attracts its armature more strongly the contact shifts its point, and introduces into the circuit a greater number of turns of the coil; the resistance increases, and the strength of the current diminishes accordingly. If the current decreases below the standard strength the reverse effect takes place. Practically, this device may prove useful in galvanoplasty, in the incandescence of platinum and iridium wires to prevent fusion, and the introduction

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of the electric light into homes. A simple and effective contrivance of this kind is worthy of an inventor's attention just now.

ELECTRICITY IN AIR.—Recent experiments of M. R. Nahrwold tend to demonstrate that it is the dust in air and not the air itself which becomes electrified. When air is sifted of dust by means of glycerine, it takes only a very feeble charge. M. Nahrwold also remarked that positive electricity discharges itself more readily in air than negative, a result contrary to those of Wiedemann and Ruhlman, and we think also of Thomson. During the electric discharge, when viewed by the light of the mechanical theory of gases, would seem to show that the discharge, besides increasing the *vis viva* of the moving molecules, also increases the *vis viva* of the oscillatory motion of the ether envelopes. Different spectra got from different points in the width of the gaseous tube are therefore not to be referred only to the different temperatures of the gas, but to the amounts of electricity of which the passage causes the oscillation of these ether envelopes.

ELECTRIC LUMINOSITY OF GASES. — M. Eilhard Wiedemann from experiments made by passing discharges from a Ruhmkorff induction-coil excited by two Bunsen cells through a tube filled with air, has determined that a gas may become electrically luminous by the passage of electricity through it, while yet at a temperature far below 100° C. Indeed, 62° C. is not the lowest temperature at which a gas may emit light under this condition.

AN electric water-level indicator has been fitted up by the Silvertown Company at the New Water Works, Leamington. A rise or fall of the water level applies the positive or negative pole of a battery to the indicator for a certain time, and causes the hand to indicate the new level in feet. A similar instrument, designed by the Postal Telegraph Engineers, was fitted some months ago to a reservoir of the Nottingham Waterworks Company, and has given great satisfaction.

New Patents—1879.

1476. "Telephones and telephonic call mechanisms." H. J. HADDAN (communicated by A. M. Rosebrugh). Dated April 16.

1477. "Telephony." H. J. HADDAN (communicated by G. Black, and A. M. Rosebrugh). Dated April 16.

1531. "Improved arrangements or apparatus for telephonic and microphonic purposes." J. W. T. CADETT. Dated April 18.

1549. "An improved method of forming matrices for electro-typing line and pattern rules, and in appliances used therefor." D. CULROSS. Dated April 19.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.—1878.

3622. "Submarine electric telegraph cables." WILLOUGHBY SMITH. Dated Sept. 13. 4d. This invention consists in forming cables of light specific gravity, such that their strength shall not be impaired by long immersion. The conductor is coated with gutta-percha in the ordinary manner, but a steel wire sheathing is laid round it in long open spirals, and imbedded in the outer coating of insulating material. This outer coating may be a mixture of gutta-percha and shellac, and the wires may be imbedded either by heating them or the material.

3744. "Telegraphing on board ship." E. A. CAMMADA, of Delft, Holland. Dated Sept. 21. 6d. A series of thirteen electro-magnets are arranged round a circle, and the signal is made by actuating any one of these by the current, so that it attracts an armature and lever over the electro-magnet in question. A dial indicates the motions of the armature and the command. This contrivance can be applied to steering.

Proceedings of Societies.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the meeting on the 22nd of April, Mr. BATEMAN, President, in the chair, the Paper was read on "Dioptric Apparatus in Light-houses for the Electric Light," by Mr. JAMES T. CHANCE, Assoc. Inst. C.E.

The author briefly premised that in the Fresnel or dioptric system, the source of light occupied the central position within a structure of glass zones, or annular segments, by which the incident rays were condensed and directed on the sea; and that there were two principal kinds of dioptric apparatus, the fixed and the revolving. He then proceeded to make some observations concerning the different optical treatment which a small radiant like the electric arc required from that which suited an ordinary flame. In the latter case, as, for it concerned sea-lights, the object was not only to parallelise all the rays emanating from any point of the luminary, but also to reduce the vertical divergence due to the height of the flame by increasing the diameter of the optical instrument. On the other hand, the smallness of the electric arc afforded the opportunity of obtaining from the dioptric zones or other elements, by suitable generating sections, whatever divergence, whether horizontal or vertical, might be desired. It was also pointed out that the source of light, in the case of the electric arc, could not be entirely depended upon for maintaining the same position in relation to the focal horizontal plane; and that consequently, since the vertical divergence due to the luminary would move upwards or downwards with any vertical displacement of the radiant itself, the mariner could not be absolutely secured from failing to see the light, unless a special vertical divergence were given by the dioptric apparatus, independently of that caused by the size of the electric arc. This, however, involved the adoption for this illuminant of a dioptric instrument considerably larger than what was originally contemplated, so as to reduce materially the luminary divergence, and thereby be free to substitute for it, to some extent, a special vertical divergence.

The author stated, that in 1862 he had expressed himself in favour of a much larger apparatus than was then employed with the electric light at Dungeness. Also that in 1865, Messrs. D. and T. Stevenson had recommended a third order apparatus for the purpose, in their report to the Commissioners of Northern Light-houses. A similar result was arrived at by the Elder Brethren of the Trinity House, in 1869, in consequence of comparative trials instituted by Professor Tyndall, for testing the relative merits of a sixth order light, and a third order respectively, when used with the electric radiant.

The Souter Point Revolving Light, which was first exhibited in January, 1871, was described. Reasons were assigned for adopting two optical agents—one to condense the light in the vertical plane, the other to produce the required horizontal compression—instead of attempting, even for the refracting part of the apparatus, to effect the two condensations respectively

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by a single agent. Reference was made to the proposal of Mr. Thomas Stevenson, M. Inst. C E., for attaining this latter desideratum; as likewise to that of Mr. Brebner, M. Inst. C.E., with a similar object. The method actually adopted was similar to that which had been already employed in France for the revolving light with the electric arc. It consisted of a fixed third order light encircling 180°, and of a rotating octagonal drum of the same height surrounding it. Each side of this drum, comprising three panels in height, was composed of vertical refracting prisms, by which the light, radiating in azimuth from the inner fixed apparatus, was compressed horizontally into a beam of 7° 8′ divergence in addition to that due to the diameter of the electric arc. This was done in such a manner that every single prism had its own independent divergence of the same amplitude, whereby was obtained an extent of light-emitting surface of a height of 6½ feet and of 22½ inches in breadth. Stress was laid upon its being the characteristic feature of the beam issuing from any one of the sides of this glass drum that, in passing before the eye of the observer at sea, its brilliancy would, from first to last, remain unchanged, as distinguished from the waxing and waning appearance of the ordinary revolving light; consequently, at whatever distance the flash might be visible, the interval of its duration would be the same. Attention was also directed to the valuable suggestion made by Mr. J. N. Douglass, M. Inst. C.E., the Engineer to the Trinity House, that advantage should be taken of the landward hemisphere of the radiant light of the electric arc, to provide a beam which should be made to issue through a window in the tower below the main light, in order to mark certain dangers in Sunderland Bay; and it was stated that 54·6 per cent. of the rearward hemisphere of light had been thus utilised.

The two fixed lights which were inaugurated at the South Foreland, in January, 1872, were described. It was explained how the whole of the catadioptric zones—both upper and lower—were in both lights made to parallelise the rays in the usual manner. The light, however, incident on the refracting portion of each light was distributed over the sea from the horizon to within a short distance from each tower, by a succession of increasing angles of vertical divergence, so that the illumination of the sea became gradually diminished as the distance from the land was lessened. In each light there was a rearward arc to spare, and this was turned to valuable account, from 67 to 71 per cent. of this light being collected and acted upon by optical agents, which were particularly described, as thereby distributed uniformly over the front azimuthal arc, so as to intensify not only the illumination of the horizon and the distant sea, but also that of the nearer sea.

It was mentioned that the two Lizard Lights, which were both fixed, and were first exhibited in March, 1878, had optical arrangements similar in every respect to those adopted at the South Foreland Light-houses, with a slight variation in the refracting portions, arising from the circumstance that existing apparatus had to be turned to account in the construction of each apparatus.

A table was appended, showing the condensing powers in the direction of the horizon of the lights described in the paper, distinguishing those optical portions which parallelised the incident light from those which gave to it special vertical divergence. According to this table, upon the assumption that the diameter of the electric arc was 12 millimetres, the condensing powers in the sea-horizon direction were as follow:—

Souter Point—Revolving - -	236·38
South Foreland—High Fixed - -	50·17
South Foreland—Low Fixed - -	43·40
Two Lizard Lights—Fixed - -	58·44

and data were added for adopting this Table to particular cases.

In a second table was given the respective condensing powers over the near sea, at different distances from the light-house towers.

THE SOCIETY OF TELEGRAPH ENGINEERS.

At the ordinary general meeting of the society held April 23rd, Major Bateman-Champain, President, in the chair, a Paper was read by Mr. ADAM SCOTT, on "Recent Improvements on Professor Bell's Telephone."

In commencing his paper, Mr. Scott said that since Professor Bell's paper, no communication on the subject of that gentleman's telephone had been made to the society. Since that period very great success had attended the use of the instrument, especially in America, where no less than 26,000 telephones were in daily use at an annual rental. The exchange system by which different telephonic circuits could be switched through to any other circuit at a central depôt, was in active use. At Chicago, 700 subscribers worked their telephonic lines on that system, and the number of calls made through the central office exceeded 8,000 daily. Referring to the limited use of the instrument in England, where the number employed was stated not to exceed 500, Mr. Scott said that bad management was the cause that had checked the general introduction of the instruments into use. Also it was his opinion that the public had formed an erroneous judgment of the capabilities of the telephone from having heard instruments of an inferior manufacture. Telephones, although simple in principle, required to be constructed with care and good materials, otherwise they were sure not to give continual satisfaction; the magnets of such instruments were far too weak and too small, and the diaphragm being consequently set too near the pole of the magnet, frequently became bound against it by change of temperature. The magneto bell calls tried were also found to fail, and even battery calls could not be relied on in the hands of inexperienced persons.

Mr. Scott then described the telephone of Mr. F. A. Gower,* pointing out its several advantages. The use of a flexible mouth and ear tube allowed the telephone to be fixed, and consequently all liability to the connecting wires becoming broken was avoided; also the introduction of a call consisting of a vibrating reed caused to vibrate by blowing through the tube was a great improvement. The magnets of this telephone were of French steel of a highly porous nature, and were capable of sustaining ten times their own weight; the diaphragm also was thicker than that usually employed, and the whole being enclosed in a strong metal box was not affected by climatic changes.

At the conclusion of his paper, Mr. Scott practically demonstrated the capabilities of the instrument, and showed that the voice could be heard even if the speaker stood several feet distant from the instrument.

In the discussion which followed the reading of the paper,

Mr. PREECE pointed out that every disc of the telephone had its own fundamental note, and that a voice sounded in that key could be most distinctly heard. Referring to the comparative use of the instruments in America and England, Mr. Preece agreed with Mr. Scott that bad management had checked its use in England, but at the same time, said that the number in use considerably exceeded 500, as a large number were employed which did not pay a royalty. He thought that the extensive use of telephones as well as call instruments in America, was due to necessity, as it was

* See TELEGRAPHIC JOURNAL, March 1st, p. 75.

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difficult there to obtain errand boys to carry messages. The difficulties which ensued from induction on lines when fast speed instruments were employed was also pointed out as a reason why the telephone was not extensively employed.

Major WEBBER criticised some of Mr. Preece's remarks as to the effectiveness of the telephone, and pointed out the use that was made of it by the telegraph lineman when searching for a fault, the telephone enabling them to communicate readily with the nearest station.

Lord LINDSAY in speaking of the question of induction between telephonic and other circuits, stated that a telephone circuit which run parallel to other circuits for a few yards, and six yards distant, was distinctly affected by the currents in the other wires. He had found the telephone a very useful instrument.

Professor AYRTON pointed out that the diaphragms of telephones should be of such dimensions as not to be able to vibrate slowly, in fact, should have a "dead beat" action. He suggested two diaphragms with a viscous liquid between them as likely to effect this object.

Mr. SCOTT in replying to an objection raised with reference to the use of the flexible tube, stated that its employment so far from being prejudicial was quite the reverse, as it improved the articulation to some extent.

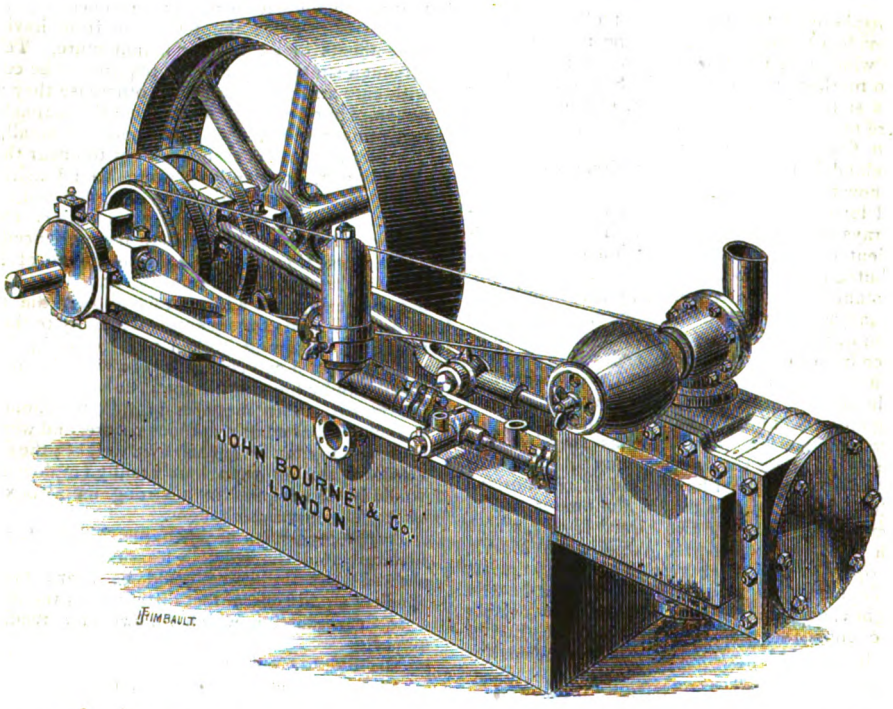
General Science.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

IV.

Bourne's Balanced High-pressure High-speed Engine.

IT has long been maintained by Mr. Bourne that the steam engine of the future would be one which is driven at a high-speed, the moving parts being all designed so that no unbalanced momentum may cause a tremor.



The benefits which the high-speed system possess are numerous; not only is the noise and complication of gearing avoided, but, as an engine with any given pressure of steam will generate a given amount of power at each stroke, whether the strokes per minute be many or few, it is clear that the amount of power generated by a given engine in a given time will be in the simple ratio of its velocity; and hence a given power may be generated with less first cost, with less weight of metal, and with less space occupied by a fast engine, than by a slow one.

Again, the benefit of working steam engines expansively is well known to engineers, as also the necessity of employing a steam jacket in engines so worked, to obtain the full benefit of the expansive principle. It is not generally known, but is nevertheless the fact, that in high-speed engines there is a further benefit arising from the inability of the cylinder to become sensibly heated and cooled at each stroke, from the shortness of the time given for that process, and in such engines the cylinder approaches to the condition of a non-conductor, which is known to be favourable to the economical generation of power. Then, in the case of all high-pressure engines, it is easy to see that a considerable pressure must be more beneficial than a lower

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pressure. To raise a given quantity of water into steam takes just the same quantity of heat, whether the evaporation is effected at the pressure of the atmosphere or at six or eight times that pressure. But at the low pressure the steam will not generate any power, whereas at the high pressure it will generate much power. A very high pressure of steam, however, is inconvenient, as it involves a correspondingly strong and heavy boiler, an extra strong and heavy engine, and separate expansion gear, which is not compensated by the small amount of increased economy obtained from excessive pressure. A pressure of about eight atmospheres is found to be, on the whole, the most eligible that can be adopted.

The figure shows one of Mr. Bourne's high-speed engines, employed in generating the electricity for the electric light at the Polytechnic Institution, in Regent Street.

The proportions of these engines for all powers is as follows :—

Extreme length of engine, about 8 times the length of stroke.

Extreme breadth of engine, about 5 times diameter of cylinder.

Breadth of fly-wheel for strap, about 1½ times diameter of cylinder.

Diameter of vertical boiler, about 8 times diameter of cylinder for small, and 6 times for larger powers.

Height of boiler, about 2½ times its diameter.

Working pressure in boiler, 120 lbs., tested to 240 lbs.

Water required for feed, about ½ cubic ft. per *indicated* horse-power per hour.

Coal consumed, about 3½ lbs. per *indicated* horse-power per hour.

In addition to the engines, which have been already described, those manufactured by several other firms are worthy of notice, as being especially adapted for driving electric-light machines, amongst others, the engines of Messrs. Marshall, Sons, & Co., of Gainsborough, and also Messrs. Tangye, of Birmingham. Messrs. Marshall's engines are fitted with patent automatic expansion gear, which insures the greatest regularity in the working.

City Notes.

Old Broad Street, April 28th, 1879.

THE competitive Atlantic telegraph scheme mentioned frequently by us, now appears to be rapidly entering on the field of action. There will doubtless be a gigantic struggle between the two combined companies and that which is about to lay two other cables between France, England, and America. It is almost needless to say the interest taken in the matter is growing fast, the large capitals involved in the older enterprises, rendering the intended competition a most serious matter for the shareholders in them. With the Direct United States Company, we all know what happened; the shares were depressed by low tariffs and they were then bought up by some prominent members of the antagonistic company. The voting majority having been thus obtained, it became then a comparatively simple matter to amalgamate (practically) the two undertakings. Doubtless this has been provided against in the formation of the new company, the shares being in the hands of a few large holders. It remains then to be seen what will be done by the antagonists. If low tariffs prevail, the company with the heaviest load of capital would suffer most, supposing the traffic shared equally; but this at first could hardly be the case. The exact proportion which the new company will take depends on various circumstances, difficult to estimate beforehand. It will, however, have an immense advantage in the services of M. Von Chauvin, who gained so much experience in the late Anglo and Direct war; his clever management of the latter company during that contest is fresh in the memory of most of us. Lord Monck, the other day stated, that the "Anglo and Direct Companies had by special agreements the right to bring almost every message which crossed the Atlantic from America here, and they had priority in, he believed, all European countries over any other company which might exist—that was to say, the governments of all European countries, France included, were bound to send all messages transmitted to them by these two companies' lines, unless the sender directed to the contrary." We have not the slightest doubt that M. Pouyer Quertier and his colleagues, have well considered this part of the question, the want of *common sense*, mentioned by the noble lord, notwithstanding, they probably have well studied everything in connection with it, and we shall look with interest for the result of the forthcoming inevitable struggle. The public, no doubt, will be glad of low tariffs, and if all three companies can with these, pay dividends and provide reserve funds, so much the better for all concerned. This, however, we fear, will not be done.

WEST COAST OF AMERICA TELEGRAPH COMPANY.—The second ordinary general meeting of the shareholders of this Company was held on Thursday, the 10th inst., at the offices, No. 98, Cannon-street, under the presidency of Mr. Neil Bannatyne. An abstract of the report appeared in our last issue. The Chairman, in moving its adoption, said the report was rather long. The directors had gone as fully as possible into all matters connected with the Company, so that the shareholders might have as clear an idea of the exact position of the concern as the directors were able to supply them with. The report was, therefore, so full that, if he made any further observations at that moment, he should only recapitulate the statements it contained. He would, however, be happy to reply to any questions, and, in that manner, perhaps, give further information. The motion having been seconded, Mr. Small said that the capital was stated at £300,000, while the cost of the cables, land lines, and instruments was set down at £425,000. He regretted that there was £150,000 debentures, the interest on which had to be provided before the ordinary shareholders received anything. He feared it would be some time before they received anything. Dr. Beattie was not so despondent. The debenture-holders had voluntarily relinquished 2 per cent. of the interest to which they were entitled, and now received only 8 per cent., and with an improvement in trade he trusted that the ordinary shareholders would receive some dividend. He asked how the steamer, the *Retriever*, was employed. Another shareholder asked what effect the war between Chili and Bolivia would have on the Company's traffic. The Chairman, in reply, said that the balance-sheet clearly showed the amount of the capital and how it had been expended, and it also showed what really were the assets of the Company representing the capital. The object of the directors had been to place the accounts on as sound a basis as possible, and they had written off out of revenue all the preliminary expenses of forming the Company, and the working expenses of the steamer preparatory to her being placed on the station; so there were no assets which were not really available

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assets. When they had a surplus of revenue they would be in a position to pay a dividend on the ordinary shares. They could not prophesy when they would be able to pay a dividend on the ordinary shares—it depended entirely on their traffic. When the cables were laid down business was in a more active state in Peru than had been the case ever since, and the traffic had certainly not come up to the expectations originally formed of it, partly from this cause and partly from another cause not within their control—the interruptions to neighbouring lines. The steamer had made one voyage carrying water, and she had also been employed in carrying cargo and towing. She was fitted up and ready for employment in any of the ways stated in the report. She was an excellent vessel. All their cables were in working order, and the cable in store was in perfect electrical condition. They could not tell what effect the war between Chili and Bolivia would have on their traffic, but he thought he might say that for the present month it would have a very favourable effect on the local traffic. The debenture interest was 8 per cent. on £150,000. Any one could see what that amounted to, and the position of the ordinary shareholders as to dividend. Their expenses were excessively small, and it would be their policy to keep them down as much as possible consistent with efficiency. Mr. Gray remarked that the Company's cables extended from the capital of Peru, past Bolivia, on to the capital of Chili, Valparaiso, touching at various intermediate posts. Before war was declared they were asked to connect Autofogasta, one of the Bolivian ports. He then referred to the causes out of which the war arose, and afterwards stated that there would probably be one length, from Autofogasta to Iquique, through which no messages would go; but he anticipated a great local traffic. He felt satisfied that neither of the Governments would injure the cables, because in peace they derived such great benefits from them. In fact, the Presidents of Chili and Peru had told him that they would do all they could to preserve the cables. The report was then unanimously adopted. The other business was disposed of, and the meeting closed with the usual complimentary vote.

SUBMARINE CABLES TRUST.—According to the Report of the Trustees, the revenue for the year was £26,165, from which £1,890 was expended in the purchase of twenty certificates, and £2,000 has been deducted for expenses, leaving a balance of £22,275. Of this sum £10,362 has been applied to the payment of the coupons due on October 15th last, and the balance of £11,913 is carried forward. The amount required to pay the coupon on the 15th inst. is £10,362.

The Western and Brazilian Telegraph Company (Limited) notify that telegrams for Chili, Bolivia, and Peru are subjected to a scrutiny by the authorities in Valparaiso, and stopped or forwarded according to their discretion. The authorities in Valparaiso also intimate that no refund will be made for messages so stopped. This company likewise announce on April 25th, the repair of their Para-Maranham section.

In order to promote the carrying out of an arrangement concluded between the Telegraphic Administrations of Germany and Norway, a company was constituted on April 23rd, in the office of the United German Telegraph Company for the laying and maintenance of a cable between Germany and Norway.

Direct United States Cable Company (Limited). The Board of this Company have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of five per cent. per annum, for the quarter ending March 31st last.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 55-55½; Ditto, Preferred, 84-85; Ditto, Deferred, 27-27½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅛-6½; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10-10½; Direct United States Cable, Limited, 1877, 10½-11½; Eastern, Limited, 7⅛-7¼; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 100-103; Eastern, 6 per cent. Preference, 11¾-12; Eastern Extension, Australasian and China Limited, 7⅛-7¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; German Union Telegraph and Trust, 7¼-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10½-11½; Great Northern, 7½-8½; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9¾; Reuter's, Limited 9½-10⅛; Submarine, 220-230; Submarine Scrip, 1⅞-2⅛; West Coast of America, Limited, 1¼-1½; West India and Panama, Limited, 1¼-1¾; Ditto, 6 per cent. First Preference 8½-9; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 3¾-4; Ditto, 6 per cent. Debentures "A," 93-97, Ditto, ditto, ditto, "B," 87-92; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 114-118; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 29½-30; Ditto, 6 per cent. Bonds, 107-109; Ditto, Second Bonus Trust Certificates, 2⅛-2¼; India Rubber Co., 10¼-10¾.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £166,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West. Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,216.
	£	£	£	£	£	£	£	£	£	£	£	£	£
March, 1879 ...	47,550	13,052	3,100	929	15,850	41,225	26,185	15,401	... ...	9,790	... ...	11,688	5,191
March, 1878 ...	48,630	14,239	3,517	880	11,580	38,201	23,112	18,156	... ...	10,055	3,425	12,300	6,377
Increase	... ...	... ...	... ...	49	4,270	3,024	3,073	... ...	... ...	... ...	... ...	... ...	... ...
Decrease	1,080	1,187	417	... ...	... ...	... ...	... ...	2,755	... ...	265	... ...	612	1,186

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 151.

THE ELECTRIC LIGHT.

THE Electric Light has had a jubilee; not indeed one of those silver weddings or golden weddings which are so frequent just now among successful sovereigns and public men, but a coming-of-age festival, which stamps it as a practical necessity of civilized life. For it is in the light of a jubilee that we must regard the magnificent exhibition of electric lighting apparatus of all nations which was inaugurated by the Prince of Wales last Wednesday evening in the Albert Hall. Mr. W. H. Preece, who from the stentorian power of his lungs, and his well-known facility as a popular expositor, was both mentally and physically well chosen to deliver the opening lecture, and the President and Council of the Society of Telegraph Engineers, deserve the thanks of electricians in general for conceiving the exhibition and carrying it out to a successful issue. The Prince of Wales, in consenting to preside over it, gave it a dignity which otherwise it would have lacked in the eyes of the people, and, by this courteous act, has helped to ingratiate himself with our profession.

The past year has been an important era in the history of the electric light, perhaps the most important it ever experienced. Hitherto the electric light had led a dilatory and tentative existence, with occasional spasmodic bursts of vigour which as quickly died out again. But during the last twelve months it has developed so rapidly that, instead of being a thing almost unknown to the world at large, it is the subject of every person's talk, and the recognised illuminant of the future. It has established itself as a formidable rival to gas: a rival whose permanency is assured, and whose improvement only is a matter of speculation. During the past year it has accomplished its majority, and it speaks well for the coming light that the event has been so highly distinguished. We can imagine the ill-disguised smile, or rather sneer of contempt, with which a gas director would read the foregoing complimentary lines. The gas companies have now fallen into a habit of utterly repudiating the electric light. From panic they have oscillated to sheer scepticism, and, secure in the failure of Mr. Edison's system, they ignore all others. Complaints are rifer than ever about the poor quality of gas, and the unprecedented number of cubic feet which everybody has been burning of late. It is as if the gas had taken upon itself to be revenged for the scare which the new electric light gave it, and had played tricks on the meters. But gas directors ought to know that it is as unwise to pooh-pooh the electric light now as it was hasty to dread it before. Jablochkoff's system has been tried in London for street lighting, and found to be more expensive than gas; but that is a very insufficient basis to condemn an enemy upon. Jablochkoff's system is only one of twenty different systems which have yet to be tried for street lighting; and, further, each of these, including the Jablochkoff, is capable of improvements, which only suggest themselves when the apparatus is put on trial. The electric light is progressing in the streets of Paris, and it is being extended to other cities in France, notably Lille. In France gas is dearer than in England, hence the difference in cost is less marked than with us. The beauty of the electric light also enhances its value, in Paris at least, more than in London, where the brilliant beams, instead of lighting up beautifully sculptured boulevards and pellucid air, only unmask the hideousness of our dingy brick thoroughfares and murky atmosphere.

That the electric light is no longer to be despised by the gas companies is amply proved by the statement made by Dr. Siemens before the Committee on Electric Lighting, now sitting in the House of Commons, to the effect that the firm, of which he is the head, had manufactured £57,000 worth of electric lighting apparatus during the past year. Factories of all kinds, in different parts of England and the continent, are adopting the electric light, as being not only superior but cheaper than gas-light. That the electric light when produced by a few intense sources and properly diffused is far more economical than gas for the illumination of large halls and workshops, is proved by the ordinary lighting of the Albert Hall, where five Siemens lamps, costing £2 10s. per night and yielding a light equal to 45,000 candles, have superseded some 3,000 gas burners which formerly cost £7 per night in consuming 42,000 cubic feet of noxious gas. Electrically lit factories and halls may not much diminish the total revenue of the gas companies; but these factories and halls are only the beginning of a conquest which will gradually extend itself and may ere long spread not only to streets but to dwelling-houses.

It is true that Mr. Edison has not fulfilled the extravagant expectations which his own hasty acts engendered in the public mind. But we are much mistaken in Mr. Edison if he does not in time attain a measure of success which will, to a certain

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extent at least, make good his words. He is sanguine, but he is also persistent; he is probably even rash; but he is very ingenious; moreover, he is young, and the declared foe of the gas companies, therefore let them not despise him. Half of his reputation depends on his success in electric lighting; and, despite his seeming failure thus far to render it practicable, we cannot but think that he has shown the instinct of a true inventor in seizing upon the incandescent mode of electric lighting for domestic purposes, and abandoning the voltaic arc.

Whether Mr. Edison be successful or not, however, and, according to latest reports, he himself states that he is, there are hundreds of other inventors of tried ability at work upon the problem of electric lighting; and that their success thus far is no mean one, has been amply demonstrated by the recent splendid exhibition at the Albert Hall.

MUIRHEAD'S DUPLEX SYSTEM.

By A. MUIRHEAD.

So much has been written upon the subject of "duplex" telegraphy during the last few years, that it will be unnecessary for me to explain here how it is that two messages can be sent in contrary directions along the same wire simultaneously. A short outline of the history of this method of doubling the working capacity of a line may not, however, be amiss.

Dr. Gintl, a director of Austrian telegraphs, may be regarded as the founder of duplex telegraphy. In 1853, he described his system to the Academy of Sciences, Vienna, and tried it practically on a land-line between that city and Prague. In this original system the receiving instrument is placed between the battery and line, in such a position, that when the circuit is completed, by closing the key, the current flows through the receiving instrument into the line. With a receiving instrument, as ordinarily constructed, this current would produce a signal, but as it is essential for duplex working that sending from a station should not affect the instrument at that station, Gintl wound his instrument in a reverse direction with a second wire, and in order to counteract the effect of the signal current on the needle, he caused the current from a second, or "compensating" battery, to pass round this second coil. By means of resistance coils he adjusted the current in the compensating circuit till it exactly neutralised the effect of the signal current in the main circuit. The signal key being fitted with double points closed both circuits at the same time. Thus the receiving instrument was guarded against the influence of the sending currents and preserved free to indicate the received currents.

In 1854, Gintl's method was greatly improved by Herr Carl Frischen, a telegraph engineer of Hanover, who made the receiving instrument "differential," in other words, instead of winding it with two dissimilar wires as Gintl had done, he wound it with two wires as similar as possible but in contrary directions. By this devise he was able to employ a single battery, in sending one-half of the current through one coil of the instrument into the line, and the other half through the other coil into the compensating circuit, which was made equivalent in resistance to the line itself. This "Differential Method," as it is called, appears to have been re-invented a few months later by Messrs. Siemens and Halske, of Berlin, and is, therefore, sometimes termed the Frischen-Siemens method. It was tried in Prussia, soon after its invention, but gradually fell into disuse through a difficulty in maintaining the equivalence of the real and the artificial or compensating lines.

In 1863 M. Maron of Berlin adapted the principles of the "Wheatstone Balance" to duplex working, and as this arrangement of the apparatus is

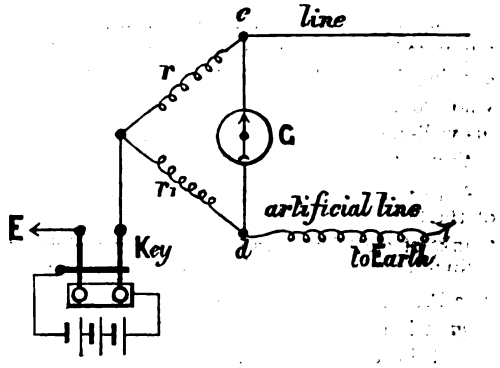

FIG. 1.

that chiefly employed in connection with Muirhead's system, I will describe it in some detail. Fig. 1 represents a theoretical plan of the connections in the "Wheatstone Balance Method" of duplex working. The proportional resistances r r', are usually made equal to each other; so that by the principle of the Wheatstone Balance, the artificial line must also be made equal to the actual line. When this is accomplished, a signal current, sent from the battery on manipulating the key, will have no effect on the receiving instrument placed in the diagonal or "bridge wire" c d. It will simply divide itself at the point b, one-half flowing by the branch r into the real line, and proceeding to the distant station, while the other half flows by the branch r' into the artificial line, and so to earth. The potential at the points c and d being equal, there will be no cross current through the bridge wire, and a balance upon the receiving instrument will be obtained. The home-sending will, therefore, not disturb the home-receiving instrument; but at the same time, a signal current coming in from the distant station will upset this balance and produce a signal.

This Wheatstone Balance method also failed in practice because of the difficulties met with in keeping the artificial line equivalent to the actual one. Weather changes caused the resistance of the latter to vary; but the principal trouble lay in compensating for the static induction of the line.

It is well known that a line of electric telegraph,

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like a Leyden jar, has capacity and takes a certain definite time to charge; and the larger the line the longer is this time. But in order to make a perfect balance on the instrument this period of charging should be the same or nearly the same for the artificial as for the real line. The importance of increasing the capacity of the ordinary wire resistances used in determining the balance, seems to have been recognised first by De Sauty, who employed condensers in some experiments made with the differential method of Frischen-Siemens on a line between London and Birmingham, in 1855. Mr. Joseph Stearns, an American, who revived the question of duplex telegraphy in 1868, experienced the same difficulty at first in balancing long land lines with ordinary resistance coils of small capacity, and during his trials on the long American lines the addition of a condenser was suggested in order to increase the capacity of the artificial line. This led at once to the successful application of duplex on long land lines. The "kick" jerk, or false signal, made on the receiving instrument on closing the Gibraltar cable by means of an artificial line, formed of a series of resistance coils with condensers attached to different points of the circuit, a combination which was patented by Mr. C. F. Varley, as far back as 1862, as an artificial cable or "test circuit." Mr. De Sauty's trials indicated that some closer approximation to the real cable than such a combination could practically afford was necessary to success. Mr. John Muirhead, junior, in 1873, was led to study the subject by these attempts of Mr. De Sauty, and his aim was to produce a model cable which should exactly imitate the actual one. In the following year, October 23rd, 1874, he first patented an artificial cable, which has since become the principal feature in what is now known as Muirhead's duplex system for working submarine cables. Since then the system has been developed and applied by Mr. Herbert A. Taylor, C.E., and by the writer. All the long cables of the Eastern Telegraph Company, between England and Bombay, have been duplexed on this system, as well as the Direct United States

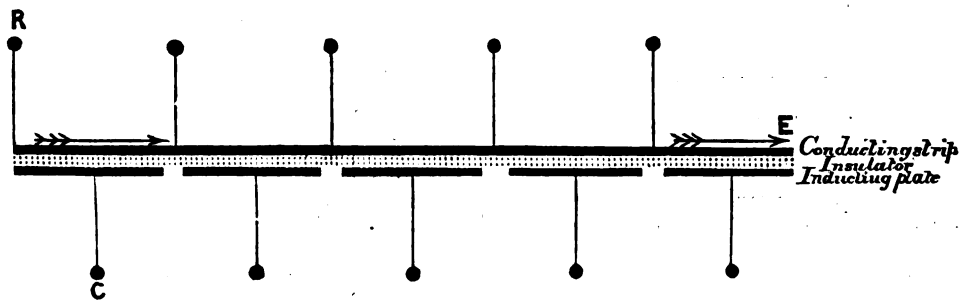

FIG. 2.

battery key by the sudden static charge due to the capacity of the actual line, was neutralised by the equally sudden charge into the condenser attached to the artificial line producing an impulse in the opposite direction. Attention now begun to be turned to duplex on submarine cables, a far more difficult problem to solve than that on land lines. On land lines the instruments are not worked up to the full carrying capacity of the line, whereas on cables they are, and the highly sensitive instruments of Sir William Thomson, the mirror galvanometer and siphon recorder, which are generally used on cables, respond to much less variations of current than are required to form signals on land line instruments. The balance on land lines need not, therefore, be so perfect as it requires to be on submarine cables. Again the static induction of a cable is far greater and more complex than that of a land line, hence the inductive "kick" is of a far more violent and inimitable character on a cable.

The experiments of the writer and Mr. Herbert A. Taylor in connection with this subject have disclosed the fact that a current enters a cable in a peculiar vibratory manner, necessitating a far closer imitation of the first portion of the cable at the beginning of the artificial line than one anticipates at first.

In 1872 attempts were made by De Sauty to apply duplex working to submarine cables. Mr. De Sauty endeavoured to "duplex" the Lisbon to cable, making a total of over 10,000 miles of cable. The first cable "duplexed" was the Marseilles to Bona section, across the Mediterranean, in 1875; the latest was the Madras to Penang section of the Eastern Extension Telegraph Company, in the latter part of last year.

The system includes both a novel artificial line or model cable, and various adjustments for bringing the first part of the artificial line into close equivalence with the first few knots of the cable, and for perfecting the balance generally. Like a real cable, the artificial line is a continuous conductor of uniform capacity throughout its length, and is best named an "inductive resistance." It is formed by taking two strips of tin-foil, and laying one over the other but separated from it by a film of insulating material such as paraffined paper. One strip forms the conducting circuit of the artificial line; the other forms the outer or inductive coating, and is connected to earth. The current is passed through the conducting strip, and exposed throughout its entire length to induction on the other strip or sheet in the same way that the current in the conductor of a cable is subjected to induction on the earth. This mode of formation is shown in fig. 2, which represents a portion of the artificial cable. The conducting strip is, as will be seen, continuous, but terminals R are connected to it at regular intervals, which include a

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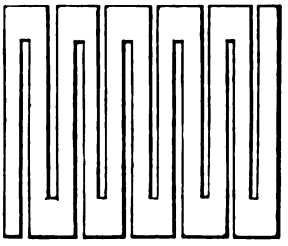
certain resistance. The inducing plates, or rather groups of plates, are, of course, diconnected from each other, but each set is connected to its special terminal c; the whole series of terminals, c, being put to earth. Each pair of resistance terminals combined with the corresponding capacity



ACTUAL SHAPE OF CONDUCTING STRIP.

terminal opposite, thus form an element of the series or unit of the artificial line, equivalent to a certain number of knots of the cable, say ten. By this mode of construction, a compact model cable can be made, which possesses the same conductive resistance, per unit of capacity, as the actual cable to be duplexed.

(To be continued.)

THE CANTOR LECTURES.

W. H. PREECE ON RECENT ADVANCES IN TELEGRAPHY.

THE first of these lectures was delivered before the Society of Arts, on Monday, the 21st instant. At the commencement of the lecture it was pointed out that light, heat, electricity, magnetism, &c., were all forms of energy, and are convertible the one into the other, as was shewn by a battery heating a platinum wire, exciting an electro-magnet, decomposing water, &c. In electro-telegraphy, the energy from a battery was caused to produce signals. The battery—the source of electricity—had a variety of forms; in the postal telegraph service, three kinds of Daniell battery were employed, viz.: the "Ordinary," introduced by Mr. John Fuller, which consisted of cells formed in a trough by slate partitions covered with marine glue, each cell being divided by a porous partition, the zinc plate being in one compartment, and the copper in the other. The "Chamber," introduced by Mr. Muirhead, had flat, porous cells, instead of the porous partitions of the Ordinary. The "U.K.," so called from its having been employed by the United Kingdom Co., had round cells, with round zincs and coppers. The Leclanché and the bichromate battery of Mr. John Fuller was also largely employed. At the Central Telegraph Station, St. Martin's-le-Grand, the number of cells worked was as follows:

	Cells.
Ordinaries	500
Chambers	12,750
U.K.'s	2,450
Leclanché's	500
Bichromates	1,650

giving a grand total of nearly 18,000 cells.

The cost of maintenance of these cells was as follows:

	s.	d.
Ordinaries	0	6 per cell.
Chambers	1	0 ,,
U. K.'s	1	1 ,,
Leclanché's	1	0 ,,
Bichromates	1	0 ,,

The various defects to which each of these batteries were liable to were pointed out, and their practical management described: It was stated that England is very far ahead of other countries as regards battery arrangements. The "open" and "closed" circuit methods of working were explained, and also the "universal" system of working several circuits from one set of batteries was alluded to; this system was being extensively adopted in England, and with success. Currents generated by thermo-piles were not found to be successful, as the forms of thermo-piles tried had all failed after continued use. Dynamic electricity, although promising, had not as yet made any advance for telegraphic purposes.

The second lecture was delivered on Monday, 28th ult. The first telegraph laid was in 1837, by Cooke and Wheatstone, the wires being buried in the ground, and insulated with cotton steeped in pitch, the wires being then laid in grooves cut in a strip of oak. Specimens of this, dug up three or four years ago, were exhibited, the name of "fossil" telegraph being given it. In 1840 the wires were erected on poles, goose quills being used as insulators. Copper wire was at first used for telegraphic purposes, but was soon abandoned on account of its liability to stretch permanently, and also from its expense. Charcoal iron wire was also used, but was found to be too expensive. But little attention was at first paid to the conductivity of the wire employed, the No. 8 iron wire at first used, having a resistance of 20 ohms. per mile. About the year 1870 the quality supplied gave a resistance of 15 ohms. per mile, and at the present day, wire of 11 ohms. resistance per mile was obtained. The wires generally employed were of No. 4, No. 8, and No. 11 gauge.

Iron wire in passing through towns was protected from corrosion by a hemp covering well tarred; copper covered wire has also been tried in South Wales, but only lasted three years, as the covering cracked. Several kinds of insulators have been used. At the present time, Varley's brown ware and Cordeaux's screw insulator were in extensive use. The number of insulators that required replacing annually was 86,000. Insulation was very difficult to maintain in England on account of the moist climate; near the sea-coast especially, the leakage was very great, the insulation resistance per mile frequently going as low as 20,000 ohms. per mile. The number of poles per mile employed varied from about 22 for light extensions to 30 for very heavy lines. The best preservative for the timber was creosote; some poles thus preserved and set up on the Portsmouth line being still in good condition. Iron poles, except for special purposes, were too expensive. The Norway pine was the wood generally used for poles. Each pole was earth wired, and had wire twisted round each arm two or three times, and connected

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to the earth wire, to intercept leakage from wire to wire, which caused "weather contact" in wet weather. Great difficulty was found in preventing leakage at the terminal poles, and a new terminal for the purpose was under trial on the principle of the Johnson and Phillips' oil insulator. The underground work in towns was gutta-percha wire, No. 7 size, the copper weighing 39 lbs. per mile, and the gutta-perch 46 lbs. The gutta-percha wire lasted about 20 years in the streets.

The mileage of line and wire at present in use in England is as follows :—

	Land lines.	Wire lines.
Road	11,055	38,821
Rail	12,952	58,127
Canal	432	4,123
Underground	446	9,024

giving a total of 24,885 miles of line, and 110,095 miles of wire. The total length of the cables in the postal telegraphs was 3,809 miles. As regards the relative costs of underground and open work, it was stated that the former was three or four times as expensive as the latter.

STEARNS' SUBMARINE CABLE DUPLEX SYSTEM.

THERE can now be no doubt that submarine duplex telegraphy has fairly passed the experimental stage and is a practical success even as regards long cables. The difficulties which stood in the way of duplexing the long ocean cables seemed almost unsurmountable, and the feat was judged by many to be impossible. The success which has attended the labours of Messrs. Muirhead and Stearns, has practically set the matter at rest, and it is practically demonstrated that the longest cable ever likely to be laid can be duplexed. Very little is at present known of the details of the methods employed for effecting the end in view, in consequence of the question of the patent rights involved not having been settled; but we hope soon to make them clear.

As is well known, Mr. Stearns has lately turned his attention to the subject of duplexing the Atlantic cables, and has had complete success. We are able, through the kindness of Mr. Stearns, to reproduce some specimens of the records very recently obtained on the 1874 Atlantic cable duplexed by his system. The difficulty of preserving a balance with such a sensitive instrument as the Siphon Recorder must be evident, and the fact that the cable has now been working for more than two months, speaks well for the system.

The speed which has been obtained experimentally is as high as 50 words per minute, that is 25 words each way. This latter is as great a speed as can be obtained when working in the ordinary way.

The following fac-simile copies of the Recorder slip will shew that the signals are as perfect as can be wished :—

Specimen of ordinary working at a speed of 25 words per minute, A.

Specimen of duplex working at a speed of 25 words per minute each way, B.

A NEW ELECTRIC MARVEL.

THE Dynamo-Induction Balance of Prof. Hughes, which will be brought before the Royal Society to-night, has been justly characterised by Prof. Stokes as perhaps the most remarkable scientific instrument of our time. It is an electric currents induction balance, just as Wheatstone's was a currents resistance balance, but of so sensitive a nature that by its means the physicist will be enabled to investigate the molecular structure of bodies, and thus to probe the recesses of matter by that subtle implement electricity. It is likely to give a great impulse to electric science, and, indeed, to research of all kinds, for there seems to be no branch of physics to which it will not prove useful. Already it has proved a wonderfully sensitive coin tell-tale or assayer, and an excellent sonometer for measuring the power of hearing. But it contains the capacity for becoming a magnetic thermometer, a stress-meter, a photo-meter (through the agency of selenium, or such-like substances), and, among other things, a delicate means of measuring not only the static capacity of condensers, but the resistance of liquids. We are compelled to defer a full account of it till our next.

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THE SOIRÉE OF THE ROYAL SOCIETY.

THE *soirée* of the Royal Society is always the principal scientific festival of the year, and that recently held at Burlington House, on the invitation of the President, Mr. Spottiswoode, and the Fellows, was as brilliant as those of former years. Statesmen, foreign ministers, including the emissary of the Celestial Empire, generals, admirals, famous travellers, and distinguished men of science crowded the reception rooms, and inspected the various apparatus there displayed. There was no real important novelty exhibited; for all the chief instruments had been made public before. The interest centred most in Edison's loud-speaking telephone (*see* TELEGRAPHIC JOURNAL, April 1, 1879), which was operated in a small hall downstairs by Colonel Gouraud and Mr. C. P. Edison. In another room the exhausted tube and electric apparatus with which Mr. Crookes has produced so many startling and beautiful effects of molecular light (*see* TELEGRAPHIC JOURNAL, Jan. 1, and Mar. 1), also attracted much attention; the rotation of a small glass turbine in vacuo by a stream of molecules, and the splendid glows produced in phosphorescent substances when exposed to the negative discharge in a highly exhausted tube. Pieces of Becquerel's luminous sulphide of calcium shone with a bright blue-violet light when the discharge played upon them; and it is said that a surface of several square inches of this material is sufficient to faintly light a room when thus treated. Grains of diamond blazed with a yellowish-green glow-worm lustre; and the ruby kindled with a rich red effulgence. Whatever degree of colour the ruby possesses naturally, the tint emitted under the negative discharge appears always of the same fulness. It is curious also to note that South African diamonds though straw-coloured in ordinary light, give out a blue phosphorescence under the discharge; while diamonds from other localities shine with different hues, such as bright blue, apricot, pale blue, red, pale green, and orange. One large fluorescent diamond gives almost as much light as a candle, when phosphorescing in a good vacuum. Perhaps Mr. Edison will get a hint here, and astonish the world with a ruby lamp, more magical than Aladdin's.

The beautiful apparatus designed by Mr. Stroh for the researches of Mr. W. H. Preece and himself into the nature of vowel sounds and the mechanical production of speech, were also much admired. In our issue for April 15, we gave some account of these instruments. One of the most novel of these was a small soft iron tongue, kept vibrating by means of an electro-magnet, which was made to utter the vowels o, ah, a, e, by simply shortening it to certain degrees. Very intricate and graceful curves were also drawn by the phonautograph, or speech recorder of Mr. Stroh. In the same room was exhibited the Telegraphic Pen of Mr. E. A. Cowper (*see* TELEGRAPHIC JOURNAL, March 1). Bright's electrical fire alarms, which, we hear, are about to be introduced into London (*see* TELEGRAPHIC JOURNAL, Feb. 15) and Tisley's small dynamo-magneto machine in which a stream of water is passed through the hollow armature to keep it cool. Dr. Settle, of Reading, also demonstrated the spiral path of the lines of force of a bar-magnet by means of a small suspended needle-magnet about $\frac{1}{8}$ of an inch in length; and Mr. Conrad W. Cooke presided over a model of Syke's Interlocking and Block System for Railway Signalling, and a signal wire compensator, whereby the position of a semaphore arm is protected from disturbance.

Various other appliances and productions were on view; sea-fowl eggs, brought home in the *Challenger* from the South Seas; water-colour drawings of the Alps, by Mr. George Barnard; photographs by Mayal; Japanese vases; drawings of the solar spectrum, executed by Captain Abney; spectroscopes by Mr. Hilyer; polarising crystals by Mr. Ladd; and a new automatic electric lamp, which burns equally well either horizontally or vertically, by Mr. Browning. There were a few sacred relics there also, preserved under glass: Roubilliac's original plaster cast of Newton's face, taken from his corpse, together with the manuscript of the "Principia"; and to the electrician, perhaps, more interesting still, the many and varied honours of Michael Faraday, with the original indenture between him and Mr. George Ribau, the bookbinder, lying over all.

EDISON'S ELECTRIC CANDLE.

MR. EDISON'S second invention patented in this country may now be seen on application at the Great Seal Patent Office. It is entitled, "Improvements in Lighting by Electricity." The letters patent bear date Nov. 7, 1878, and the final specification was filed on the 7th inst. by Edward Griffith Brewer, agent, Chancery Lane, on behalf of Thomas Alva Edison, of Menlo Park, State of New Jersey, U.S. As set forth by the patentee in the specification, the special feature of the invention relates to the candle for the diffusion of the electric light.

A thermal circuit regulator, which has been described in an earlier patent recently published, is attached at the bottom of the candle, and is so arranged that if the current becomes excessive, the regulator becomes heated, and consequently expands so as to bring a moveable spring into contact with the adjusting screw of the illuminating apparatus, and thereby diverts the current and lessens its action in the light.

Fig. 1 is a section of the candle, showing also the circuit connections.

Fig. 2 is an enlarged section of the candle detached, and fig. 3 is a perspective view of the candle portion x, which is in the form of a slightly tapering hollow cylinder, divided vertically, except at the upper end. By this arrangement he claims that uniformity and complete incandescence are secured as the electric current passes up one side and down the other. At the base of the cylinder, which is enlarged for the purpose, the electric conductors are connected. The electric current enters *n'*, passes by the wire *k*, to the candle x, up one side and down the other, there being clamps to connect the wires to the base of the split candle, thence by the circuit regulator to spring L and clamp to the other wire of the circuit.

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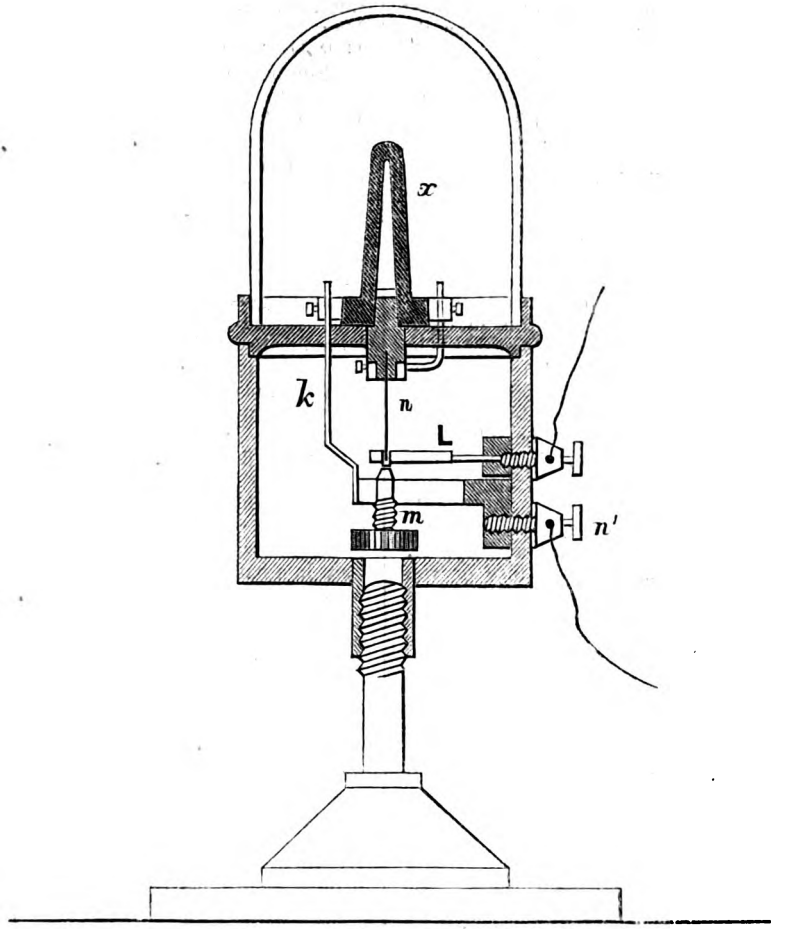

FIG. 1.

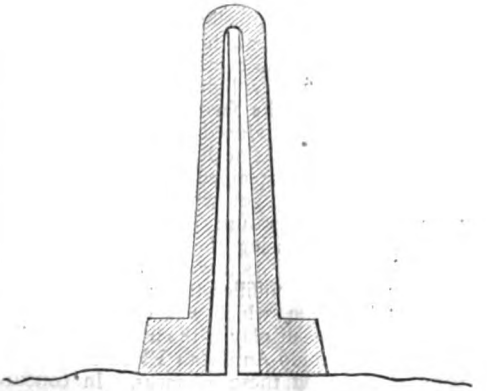

FIG. 2.

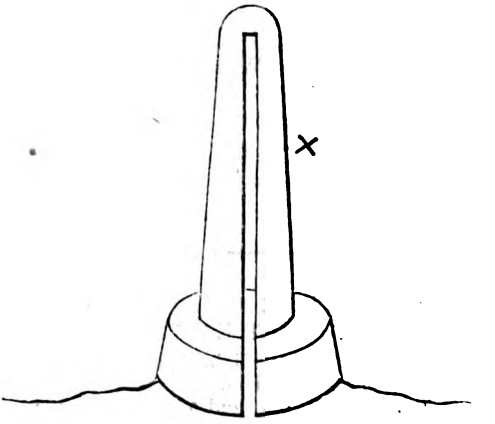

FIG. 3.

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If the current is excessive, the regulator *u* becomes heated and expands so as to bring L into contact with the adjusting screw *m*, and short circuits the current and lessens its action on the light.

Mr. Edison specifies the materials of composition and method of manufacturing the light-giving substance, the essential condition of which is necessarily its power to resist fusion by the heat developed in the passage of the current. He says:—

"Metals or oxides of metals are made use of which produce in a comparatively large candle sufficient resistance to render the whole incandescent. Finely divided metal or particles of metal having a high melting point are caused to adhere by earthy materials, such as magnesium or zircon oxides or magnetic oxide of iron, or other substances that are with difficulty fused. The oxides of metals may be obtained by chemical precipitation or otherwise, and the candle is moulded either in a dry or moist condition by pressure. The fine particles of metal may be platinum, irridium, ruthinum, or other metal. In cases where these oxides or earthy materials are mixed with the fine metallic particles, such particles are thoroughly and uniformly mixed into a mass before it is moulded, and hence such particles are kept separate by the earthy material, and cannot fuse or run together, and the metallic oxides themselves are electric conductors to a greater or less extent, and hence may in some instances be used without the particles of metal. In all cases the substances are moulded and pressed into shape under powerful pressure, and if the particles do not adhere together sufficiently, sugar, tar, silica, or similar substances may be used in moulding the candle into shape, and these substances may be volatilised by the heat. The metallic particles are rendered highly incandescent, and the earthy substances and oxides are also rendered luminous by the passage of the electric current."

Finally, the patentee declares that his invention "is not limited to any particular form in which the candle may be moulded or otherwise shaped; but it relates to the materials employed in such candles, whereby the mass is adapted to the passage of the electric current, and it is rendered highly luminous or incandescent by such current." In the statement of claims appended to the specification Mr. Edison sets forth as follows:—"What is claimed as the invention secured by these letters patent is that a candle or light-giving body for electric lights, in which particles of metal, or metallic oxides, are moulded into a mass, is adapted to the passage of the electric current and made luminous by the same, substantially as set forth."

THE ELECTRIC LIGHT AT THE ALBERT HALL.

THE exhibition of electric lighting apparatus, which was held in the Albert Hall of Arts and Sciences during the 7th, 8th, 9th, and 10th of May, was, without a doubt, the most perfect of its kind ever held before. The spacious arena of the immense hall was set apart for the more delicate instruments and plant used for the production of the light, while space was reserved outside the building for the various steam and water motors required to generate the currents of electricity. On the evening of May 7th, a brilliant assembly, presided over by H. R. H. the Prince of Wales, assisted by the Duke of Edinburgh, gathered in the magnificent auditorium, to hear the inaugural lecture of Mr. W. H. Preece, the electrician to the Post Office. Mr. Preece briefly but clearly explained the origin and rise of the electric light, and illustrated his remarks by a few well chosen and very striking experiments. That he was understood of all present was apparent by the appreciative applause which greeted him ever and anon. As he proceeded in his remarks, he called into existence, one by one, the different electric lights which were on view, and in this he was assisted by the inventors themselves. It required no small amount of courage and self-possession to conduct a lecture with so many diverse assistants, manipulating so great a variety of lamps, and with so erratic a subject to deal with as electricity; but Mr. Preece skilfully piloted his way through difficulties which would have overcome many a lecturer. While enlarging on the merits of the electric light, he did not, however, conceal its present defects. The better acoustical properties which it possesses, as compared to gas-light in a hall, were somewhat strongly put forward by him. It has been shewn by Dr. Tyndall that currents of heated air act as a sound-screen and obstruct the passage of sound-waves through the atmosphere in a very marked manner. Hence it is that the streams of hot air perpetually rising from the rows of gas-jets in a theatre or concert-room, materially interfere with its acoustical qualities, and the electric light being almost entirely free from heating power, and being, moreover, so bright that few individual lights are needed, thus offers a decided advantage over gas-light, in places where speeches or music are to be heard. It is partly for this reason that five electric lamps of the Siemens pattern have been fitted up in the ceiling of the Albert Hall, instead of the rows of gas-jets formerly employed. These lamps are kept going for less than a half of the sum required to supply an equal illumination by gas, and the only drawback to their use is a certain hissing noise which they sometimes emit, and which is perturbing to a vocalist, especially when he or she is dwelling on the higher notes. This is a slight defect, however, which will, we believe, ere long be remedied; and the greater healthiness of the new light over the old should be allowed to tell in its favour. Mr. Preece pointed out that the glow produced by an incandescent wire was preferable to that of the arc, from its steadiness and softness, and explained that, if a metal or solid substance could be got which would stand being raised to a temperature of 5,000° Fah. by the current, without fusing, the success of this method would be assured. As it was, no substance had yet been found which fulfilled that requirement, except the metal iridium, which was very scarce and expensive. A fine display of the iridium incandescent light by the Anglo-American Electric Light Company exemplified these remarks. In conclusion, Mr. Preece alluded to the growing application of the electric light in lighthouses, ships, forts, and large workshops, and, while admitting the scope there was for its improvement, did not hazard an

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opinion as to its practicability for domestic purposes.

The Duke of Edinburgh expressed his opinion that for naval purposes, such as the avoidance of collision, or discovery of torpedo boats, as well as for light-house illumination, the electric light would be of great service.

The "illustrative exhibits" in the arena of the hall consisted of a great variety of electric machines: from the earlier forms of Saxton, Holmes, and the Alliance Company, to those of Wilde, Gramme, Siemens, Ladd, De Méritens, and Schuckert. There was here also a very fine Otto Silent Gas Engine, of 3½ H.-P., exhibited by Messrs. Crossley Brothers, and driving a Gramme machine and Werdermann lamp. There were also a large number of electric lamps, including the Regulators of Siemens, exhibited by Messrs. Siemens Bros., the Dubosq, Holmes, by the Trinity House, Chapman, Serrin-Jasper, and Suisse-Hallé, by the British Electric Light Co., the Rapieff, by the National Electric Light Corporation, the Serrin-Lontin, by Mr. Harding, agent for the Lontin Company, the Wallace, by the Anglo-American Light Co., the Sautter, by the War Office, the Pyramid, by Captain Brain, and the Krupp. A row of Jablochkoff candles were fitted up round one of the balconies of the hall, and lit with fine effect. The candles of Wilde, shown by the Electric Lighting Company, of De Méritens, of Rapieff, and of Mr. André were also shown. A Reynier incandescent lamp was exhibited by Mr. Crooks, and there were samples of the lamps of Werdermann and Higgins, together with the mining lamps of Trouvé and André. Messrs. Carré and Sautter, Lemonier and Co., and Siemens, showed specimens of their improved carbon electrodes.

Besides these principal exhibits, there was an interesting collection of photometric apparatus, including the photometers of Bunsen and Wheatstone. The Trinity House exposed a fine light-house dioptric apparatus, and Messrs. Siemens Bros. exhibited a holophote, or projector, of the electric light, a powerful moveable reflector, by which an electric beam can be directed to any part of the horizon or sky. This holophote will enable a ship to scour the sea for 2½ miles around, or a fort to explore the surrounding country by night for the enemy, or the sky for balloons. The War Office furnished a specimen of the Portable Electric Light apparatus, known as the "Steam Sapper" and Mr. Trouvé displayed his ingenious instruments for adapting the electric light to surgery, which have been described in the TELEGRAPHIC JOURNAL for August 1, 1878. Nor must we forget a rich variety of elegant electric lamp posts, with opal and ground glass shades; and samples of different kinds of conducting wire and cable used in conveying the currents from the machines to the electrodes.

As nearly all these objects have already been fully described in our columns, we append the following list of the back numbers which illustrate them:—

The Gramme Machine, Jan. 15, Feb. 15, 1873; Sept. 15, 1874; Jan. 1, Aug. 15., Sept. 1., Oct. 1, 1875; Sept. 1, Dec. 15, 1876; Aug. 15, 1877; Dec. 15, 1878; Siemens' Machine, Nov. 15, Dec. 1, 1877; Schuckert's Machine, April 1, 1879; Jablochkoff's Candle, Jan. 1, 1879; Wilde's Candle, Jan. 1, 1879; Rapieff's Lamp, Aug. 15, Sept. 1, and Nov. 1, 1878, Feb. 1 and 15, 1879; Werdermann's Lamp, Nov. 15, 1878; Lontin's Machine and Lamp, May 1, 1879; the Wallace-Farmer Machine and Lamp, Nov. 1, 1878; the De Méritens' Machine, Oct. 1, 1878.

Steam motors, for driving dynamo-electric machines were also exhibited by Messrs. Robey & Co., Wallis & Stevens, Messrs. Ransomes, Sims & Head. That of the latter was illustrated in the TELEGRAPHIC JOURNAL for March 15. The Otto Gas Engine appears in the present number.

Having now given a general review of the apparatus, it remains for us to treat in particular those exhibits which we have not already described in this Journal.

ON ELECTRIC LIGHTING.*

(First Paper.)

By Dr. JOHN HOPKINSON, F.R.S., M. Inst. M.E.

DURING the last year much has been written and much information communicated concerning the production of light from mechanical power by means of an electric current. The major portion of what has appeared has been either descriptive of particular machines for producing the current, and of lamps for manifesting a portion of its energy as light; or a statement of practical results connecting the light obtained with the power applied and the money expended in producing it.

Whilst fully appreciating the present value of such information, the author has felt that it did not tell all that was interesting or practically useful to know. It is desirable to know what the various machines can do with varied and known resistances in the circuit, and with varied speeds of rotation; and what amount of power is absorbed in each case. It is a question of interest, whether a machine intended for one light can or cannot produce two in the same circuit, and if not, why not; whether a machine, such as the Wallace-Farmer, intended as it is for many lights, will give economical results when used for one; and so on. It is clear that the attempt to examine all separate combinations of so many variables would be hopeless, and that the work must be systematised.

The mechanical energy communicated by the steam-engine or other motor is not immediately converted into the energy of heat, but is first converted into the energy of an electric current in a conducting circuit; of this a portion only becomes localised as heat between the carbons of the electric arc; and of this again a part only becomes sensible to the eye as light. The whole of what we need to know may be more easily ascertained and more shortly expressed if the inquiry is divided into two parts: (*a*) what current a machine will produce under various conditions of circuit, and at what expenditure of mechanical power; (*b*) having given the electric conditions under which the arc is placed, no matter how these conditions are produced, what light will be obtained therefrom. Parts of the subject have been treated more or less in this sense by Edlund (Pogg. Annal. 1867 and 1868), Houston and Thomson in America, Mascart (*Journal de Physique*, March, 1878), Trowbridge (*Philosophical Magazine*, March, 1879), Schwendler (Report on Electric Light Experiments), but not so completely that nothing remains to be done; nor does the author doubt that a very great deal of information is in the hands of makers of machines, which they have not thought it

* Paper read before Inst. of Mechanical Engineers.

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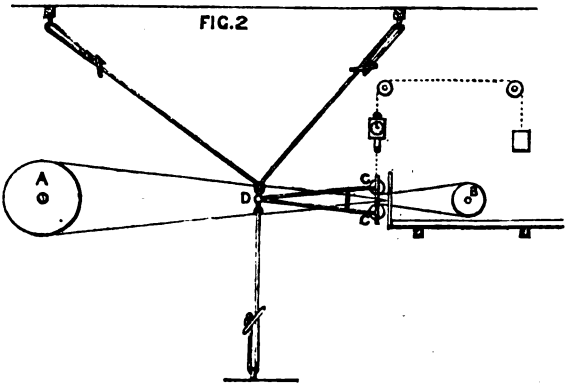
desirable to make known. The present communication is limited to an account of some experiments on the production of currents by a Siemens medium-sized machine: that is, the machine which is advertised to produce a light of 6,000 candles by an expenditure of 3½ horse-power.

All the machines for converting mechanical power into an electric current consist ultimately of a conducting wire moving in a magnetic field; and approximately the electromotive force of the machine will be proportional to the velocity with which the circuit moves through the field, and to the intensity of the field. In general the intensity of the field is not constant; and in such machines as the Siemens and ordinary Gramme machines it may be regarded as a function of the current passing. We must learn what this function is for the machine in question; or—which comes to exactly the same thing, and is better so long as the facts are merely the result of experiment—we must construct a curve in which the abscissæ represent currents passing, and the ordinates the electromotive force for a given speed of rotation. But the power of a current, that is its energy per second, is the product of the electromotive force and the intensity; this is in all cases less than the power required to drive the machine, and the ratio between the two may fairly be called the efficiency of the machine.

The object of the inquiry may perhaps be made clearer by an illustration. Consider the case of a pump forcing water through a pipe against friction; then the electric current corresponds to the water passing per second, and the electromotive force to the difference of pressure on the two sides of the pump; and just as the product of pressure and volume per second is power, so the product of electromotive force and current is power, which is directly comparable with the power expended in driving the machine or the pump, as the case may be. The peculiarity of the so-called dynamo-electro machine lies in this, that what corresponds to the difference of pressure (the electromotive force) depends directly on what corresponds to the volume passed (the current).

FIG.2



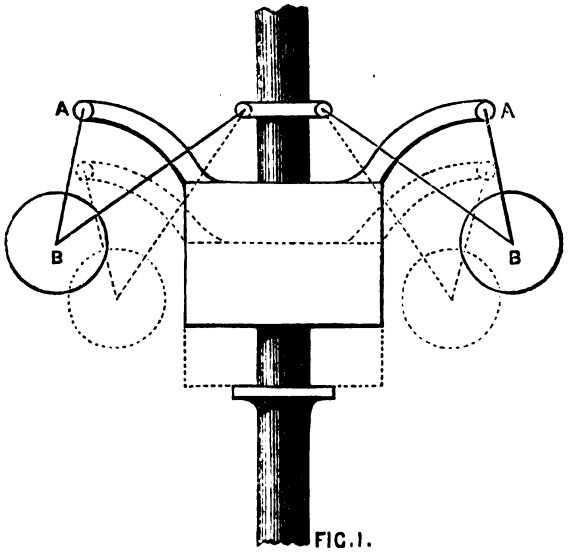


FIG.1.

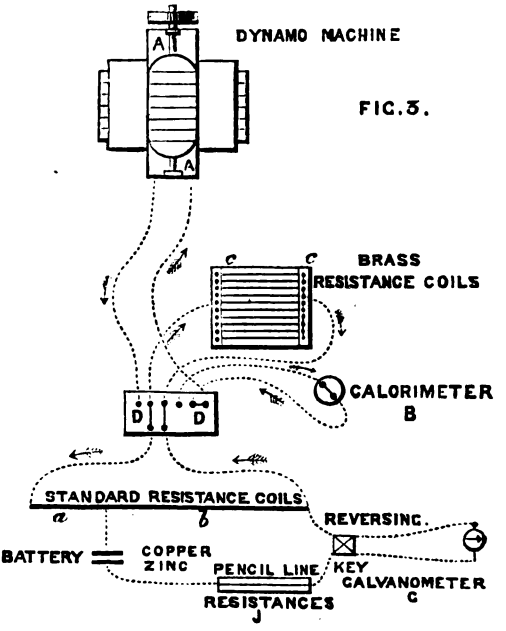


FIG.3.

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Each experiment requires the determination of the speed, the driving power, the resistances in circuit, and the current passing: or of the difference of potential between the two ends of a known resistance of the circuit.

The apparatus employed by the author was arranged, not alone with an aim to accuracy, but in part to make use of such instruments as he happened to possess, or could easily construct, and in part with a view to ready erection and transport. Much more accurate results may be obtained by anyone who will arrange apparatus with a single aim to obtain the greatest accuracy possible. The author's apparatus will, however, be briefly described, that others may form their own opinion of the importance of the various sources of error.

The speed counter was that supplied with the machine.

Concerning the steam-engine nothing need be said save that its speed was maintained very constant by means of a governor shown in fig. 1, and specially arranged for great sensibility. By placing the joint A above the joint B, instead of below it as in Porter's governor, any degree of sensibility up to instability may be obtained. The speed was varied by means of a weight and a spring, attached to a lever on the throttle-valve spindle. The ungainly appearance of this governor could easily be remedied by anyone proposing to manufacture it.

The power is transmitted from the engine to a countershaft by means of a strap, and by a second strap from the countershaft to the pulley of the machine. On this second strap is the dynamometer shown in fig. 2.

This dynamometer has for some time been used by Messrs. Siemens, and was also used by Mr. Schwendler; its invention is due to Hefner von Alteneck. A is the driving pulley; B is the pulley of the electric machine; C C are a pair of loose pulleys between which the strap passes: these are carried in a double triangular frame, which can turn about a bar D. This bar might form part of a permanent structure; but in order to place the dynamometer readily on any strap, the bar was in this case provided with eyes at either end, and secured in position by six or eight ropes. This plan answers well, as there is very little stress on the bar. From the frame immediately above the pulleys a cord leads through a Salter spring balance over snatch-blocks to a back balance-weight; the tension of this cord is read on the spring balance. At first the spring-balance was omitted, and the weight at the end of the cord was observed; but the friction of the snatch-block pulleys was found objectionable. The pulley frame carries a pointer, which is adjusted to a fiducial mark when the line A B bisects the distance between the loose pulleys. Let w' be the tension of the cord required to bring the pulley frame to its standard position when no work is being transmitted; w'' the tension which is required to bring the pointer back to the fiducial mark, when an observation is made; and let $w = w' - w''$. Let T' T'' be the tension in the two parts of the strap; R_1 R_2 r the radii of the pulleys A, B, and C, plus half the thickness of the strap; C_1 C_2 the distances A C, C B; d the distance apart of the centres C C; a_1 a_2 the inclination of the two parts of the strap to the line A B. Then

$$(T' - T'')(\sin a_1 + \sin a_2) = w;$$

$$\text{and } \sin a_1 = \frac{R_1 + r - d}{C_1} + \frac{d}{2C_1}\left(\frac{R_1 + r - d}{C_1}\right)^2,$$

$$\sin a_2 = \frac{R_2 + r - d}{C_2} + \frac{d}{2C_2}\left(\frac{R_2 + r - d}{C_1}\right)^2,$$

very nearly.

The value of $T' - T''$ and the velocity of rotation of the machine being known, the power received is readily obtained, expressed in gram-centimetres per second. Multiplying by 981, the value of gravity in centimetres and seconds, the power is then expressed in ergs* per second, and is ready for comparison with the results of the electrical experiments.

As already stated, the dynamo-electric machine in the present case was a Siemens medium size; the armature coil has fifty-six divisions and the brushes are single, not divided, that is, each brush is in connection with one segment of the commutator at any instant.

The leading wire is 100 yards of Siemens No. 90, consisting of seven copper wires, insulated with tape and india-rubber, and having a diameter of about 9·6 mm.

The method of determining the current is shown in the diagram, Fig. 3. The current is conveyed from the machine A, through a set of coils of brass wire *c*, and in some cases through a resistance coil placed in a calorimeter, and so back to the machine, the connections being made through cups of mercury excavated in a piece of wood D. The current passing may be ascertained by the heating of the calorimeter, or by measuring the difference of potential at the extremities of the resistance *c*, all the resistances of the circuit being supposed known. This difference of potential could of course be very easily measured by means of a quadrant electrometer; but as the instrument had to be frequently removed, a galvanometer appeared more convenient. The two points to be measured are connected to the ends of a series of resistance coils *a b*. The galvanometer is placed in a second derived current, passing from junction *a b* through a single Daniell element, a set of high resistances for adjusting sensibility, a reversing key, the galvanometer, the reversing key again, and so to the other extremity of *b*. The electromotive force is ascertained by adjusting *b* so that the deflection of the galvanometer is *nil*.

The resistance coils *c* comprise ten coils of common brass wire, each wound round a couple of wooden uprights driven into a baseboard common to the set; each wire is about 60 metres long, and of No. 17 Birmingham wire-gauge, weighing about 14·6 grammes per metre. Each terminal is connected to a cup of mercury excavated in the baseboard, so that the coils can be placed in series or in parallel circuit at pleasure. The resistance of each coil being about 3 ohms, this set may be arranged to give resistances varying from 0·3 to 30 ohms.

The calorimeter is a Siemens pyrometer with the top scale removed; a resistance coil of uncovered German silver wire nearly 2 m. long, 1·5 mm. in diameter, and having a resistance of about ½ ohm, is suspended within it from an ebonite cover, which also carries a little brass stirrer; and the calorimeter is filled with water to a level determined by the mark of a scriber. It was of course necessary to know the capacity of the calorimeter for heat. It was filled with warm water up to the mark, and the coil placed in position; 120 grammes of water were then withdrawn, and the temperature of the calorimeter was observed to be 58·8°C.; after the lapse of one minute it was 58·3° C.; after a second minute 57·9° C.; 120 grammes of cold water, temperature 13·3 C., were then suddenly introduced through a hole in the ebonite cover, and it was found that, two minutes after the reading of 57·9° C., the temperature was 50·0° C.; hence we may infer that the capacity of the calorimeter is equal to that of 740

* The dyne is the force which will in one second impart to one gram a velocity of one centimetre per second, and an erg is the work done by a dyne working through a centimetre; a horse-power may be taken as three-quarters of an ergten per second, an ergten being 10^{10} ergs. See Report of Brit. Assoc., 1873, and Everett "On the C. G. S. System of Units," published by the Physical Society.

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grammes of water. Two similar experiments at lower temperatures gave respectively the numbers 749 and 750. Estimating the capacity from the weight of the copper cylinder supplied with the pyrometer, it should be 747, to which must be added the capacity of the German silver wire and stirrer. Taking everything into consideration, 750 grammes may be assumed as the most probable result.

The resistance coils, marked *a b* in the diagram, Fig. 3, are of German silver, made by Messrs. Elliott Brothers, they are on the binary scale from $\frac{1}{8}$ ohm to 1024 ohms. Separate coils were used, instead of a regular resistance box, because they were more readily applicable to any other purpose for which they might be required; and the binary scale was adopted, because the coils could at once be used as conductivity coils in parallel circuit also on the binary scale. Each coil as supplied terminated in two stout copper legs; these were fitted with cups of india-rubber tubing for mercury, whereby any connections whatever could readily be made. This arrangement though rude was very convenient, and perhaps even safer from error than a box with brass plugs to make the connections. By a slight alteration of the connections the whole was instantly available as a Wheatstone's bridge to determine resistances.

The battery was a single element of Daniell's battery, in which the sulphate of zinc solution floats on the sulphate of copper; its electromotive force is assumed to be $\frac{2}{3}$ volt.

The resistances added in the battery circuit are pencil lines on glass, such as are described in the *Philosophical Magazine* of February last. Three were used, giving a range of sensibility approximately in the proportions 1, 25, 170, 700; they are very useful in adjusting the resistance *b* so as to give no deflection of the galvanometer.

The reversing key belongs to Sir W. Thomson's electrometer, and is quite suitable when high resistances and *nil* methods are used.

The galvanometer is far more sensitive than necessary, and has a resistance of 7000 ohms.

(*To be continued.*)

Notes.

THE electric-light light has superseded gas in the Place d'Armes at Lille. A fancy light placed over the town clock also displays the three national colours by means of chemical matter introduced into the arc.

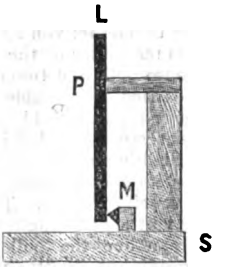
The New Eddystone lighthouse will be a granite tower rising 140 feet above the high water level of the ocean. A powerful electric light will be employed, with the use of a spare machine in thick fogs. The light will be placed about 120 feet above the water, and will command a range of 18 miles. It will revolve every minute, and its intensity will equal 180,000 standard candles.

Mr. EDISON declares that he has now made his electric light one-third the cost of gas. The Menlo Park machine shop is now regularly lit by 16 lamps, each giving a light equal to three gas gets. The lamp consists of a platinum coil in a glass bulb, about the size of an orange, and will cost about five shillings. The regulator is only required for turning up the light. He has, now, he says, contrived a machine which gives more electricity to the horse-power than either the Wallace or Gramme machines; and hopes to light up all the houses in Menlo Park in a few weeks. His new $2\frac{1}{2}$ horse-power machine feeds five Wallace-Farmer lamps.

The high importance of the electric light as a preventative of collisions at sea, was strongly advocated by Dr. C. W. Siemens in his examination before the Parliamentary Committee. But although it was solely due to the electric light carried by the *Faraday* that a most disastrous and fatal accident was prevented, the Board of Trade objected that the *Faraday* had committed an illegal act in exhibiting an electric light at sea. There is an objection to the employment of the new illuminant, on the ground that it may give rise to serious mistakes, the light carried by a ship being taken for that of a lighthouse. Through this apprehension the Board of Trade have issued regulations prohibiting the use of the electric light for ships' signals. But for these restrictions, it is said that all the Atlantic ships would use the light for signalling purposes.

SIR JOSEPH BAZALGETTE, the engineer of the Metropolitan Board of Works, has reported on the electric-lighting of the Embankment. The cost of the light is 5·78d. per hour, and to produce an equal light by gas would cost, in opal globes, 2d. per hour, and in frosted globes, 3·50d. per hour. He considers the electric light to have established itself; but to possess defects at present for general illumination.

THE PENDULUM MICROPHONE.—A very simple and efficient microphone is made by suspending a lever or pendulum of carbon, marked L in the figure, from an upright support S, by a pivot P, so that its lower end rests gently against a sharp contact piece of carbon M, fixed to the base of the frame. The point of meeting or joint is the microphonic contact, and this form is an excellent illustration of the peculiar nature of the thing called microphone. If left free to vibrate of itself the



pendulum would only do so three or four times in a second; and since it is the property of every pendulum to have an invariable period depending on its length, &c., the microphonic action clearly cannot consist in simply making the rod swing of its own accord, for if we ring the note A (equivalent to 435 vibrations a second) this microphone will distinctly transmit it, and, indeed, notes and chords of all pitches and timbres.

THE TELEPHONE is about to be introduced into Sheffield on the American Exchange principle.

THE suit brought by the Bell Telephone Company, and Morgan Brown *v.* Jackson, will, we believe, be heard on June 20th.

IN our report of the proceedings of the Physical Society will be found some interesting observations on the theory of the Bell telephone.

ANIMAL ELECTRICITY.—In a remarkable lecture delivered before the Medical Society of Zurich on February 2nd, 1878, and published in our contemporary, *Nature*, for April 17th, Dr. L. Herman summarises that "the whole of the electrical phenomena of muscle and nerve may be readily deduced from a very few simple proportions. Irritable protoplasm responds both to destructive and to exciting influences by an electro-motive sign. The altered substance takes on a

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negative potential with respect to the unaltered. This, together with the doctrines of internal transverse polarisation, and of the polarisational increment of excitation, appears fully competent to explain all the facts hitherto observed."

PROFESSOR BELL ON INDUCTION. — Touching the reference made to the twisted wire plan for overcoming induction in connection with Professor Hughes' Induction Compensator, Professor Bell writes to correct the statement that the same method had also been "lately" patented by him. He says, "I presume from this that your information has been derived from a letter originally published by Mr. Brooks in the *Philadelphia Times*, charging me with having obtained his idea through the medium of a mutual friend, and with having subsequently patented the invention as my own, in England. In my reply to this letter, which has not been as extensively copied as the original charge, I showed that Mr. Brooks laboured under a misapprehension as to the date of my patent. Instead of this being November 20th, 1878, as would be inferred from Mr. Brook's statements, the actual date is November 20th, 1877. I intend publishing shortly to the American Academy of Arts and Sciences a paper upon Induction, giving the results of my experiments in England, a copy of which I will forward you as soon as published." Professor Bell also states his intention of testing Professor Hughes' beautiful induction compensator on the American Exchange telephone lines.

THE Eastern Telegraph Company's officers at Porthcurno amuse the tedium of their solitude by negro minstrelsy, and recently gave a spirited "Ethiopian Entertainment," in Mr. Ash's lecture hall. The gorgeous Southern scenery was painted by a member of the staff; and elegantly illustrated the moving episodes enacted in front of them. Country people came from ten miles round, and the hall was crowded to excess.

WE regret to say that Mr. R. S. Brough, of the Indian Telegraph Service has just died of cholera, after very brief and sudden illness.

WE are also sorry to record the death of Mr. Adams, the well-known assistant of Mr. T. A. Edison in this country. Mr. Adams who has been ailing for some time past, died on Sunday, May 4th, at Paris. He was by birth an Englishman; but emigrated to the United States, and became associated with Mr. Edison who is ever ready to prefer ability in his employment whenever it shows itself.

PROFESSOR VOLPICELLI, the Italian electrician, died at Rome on April 14th.

HERR WOLFF, the founder of Wolff's Telegraphic Bureau in Germany, is dead.

THE physical laboratory of King's College is to be named after Wheatstone.

A CABLE manufactured by Mr. Henley has been sent out to Russia, in order to be laid across the Caspian Sea.

THE acquisition by the Government of the undertaking of the United Kingdom Telegraph Company having been recently brought before Parliament, and a memorial presented to it by Mr. J. M. Gadd, alleging frauds against the directors of that company, these gentlemen have published a declaration refuting the assertions of the memorial in question.

MR. WILLOUGHBY SMITH'S recent paper to the Society of Telegraph Engineers on the "working of Submarine Cables," has been separately published as a monograph, and will form an interesting contribution to the history of the subject.

MR. CHARLES STEWART, M.A., has been awarded a silver medal by the Academie Nationale of Paris, for his treatises on "International Correspondence, by means of numbers, an easy method whereby people of different nations may readily communicate with each other," and "how to learn the Morse Alphabet in half an hour." These books are published by Messrs. E. Marlborough and Co.

THE current from a dynamo-electric machine of Mr. Field was recently applied to telegraphy in the working of fifteen large circuits.

THE AMERICAN CABLE COMPANY propose to lay a cable from New York to Flores, an island of the Azores, the conductor weighing 500 lbs. per knot; a cable from Flores to France, England an Holland; a cable from Flores to Fayal (Azores), San Miguel and Lisbon. These will comprise 7,300 miles of core. The cable steamer is estimated to cost £70,000.

THE s.s. *Patrick Stuart*, a new repairing steamer, named after Lieut-Col. Patrick Stuart, the projector of six Persian telegraph lines, has arrived in the Thames from the Forth, where she was built. Her tonnage is 1,930, she is 235 feet long by 30 feet 6 inches wide, and 13 feet 6 inches deep. Her engines are compound and 11 nominal H.-P. She has a speed of 10 knots per hour. Her hold is fitted with four cable tanks of 24 and 28 feet in diameter, capable of holding 170 miles of Persian Gulf cable, and the iron cores of these are made to serve in fresh water tanks.

THE *Operator* informs us that the Western Union Telegraph Company has laid pneumatic tubes to connect its main office with the *Herald*, *Times*, *Tribune*, *World*, *Sun*, and *Staats Zeitung* newspaper offices in New York, so as to ensure a prompter delivery of despatches.

Proceedings of Societies.

PHYSICAL SOCIETY.—APRIL 26TH, 1879.

Prof. W. G. ADAMS, in the Chair.

MR. C. V. BOYS gave an account of some experiments made by Dr. Guthrie and himself on the subject of Arago's rotation. The experiments were begun with a view to determine if the drag on a copper disc when a magnet is made to revolve beneath it, or on the magnet if the disc is made to revolve above it, could be made use of for determining the velocity of running-machinery.

They made the magnet revolve and obtained the angle of deflection of a disc suspended by a torsion thread (the hair spring of a watch). They found, as Snow, Harris, and others found before, that other things being equal, the drag is directly proportional to the speed, so that if the torsion of the thread could be relied on, and the strength of the magnet did not change, a perfect velocimeter could be constructed. They consider that this method is better than observing the deflection of a magnet over a revolving disc, as in this case they are limited to less than a right angle, and changes in the absolute magnetism of the earth would affect the results.

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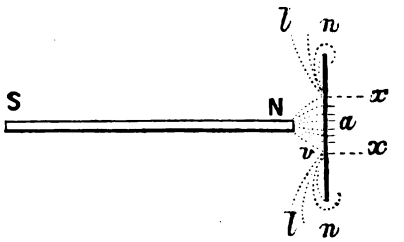
They also determined the effect of change of distance, thickness, diameter, and nature of the disc, &c., their results agreeing with those of former experimenters. They observed that the effect of concentric circular cuts was far greater than that of even many radial cuts; and that when radial sectors were entirely separated from each other the effect was much less than when these were united at the centre.

They then experimented on liquids by suspending a sphere or cylinder of the liquid between the poles of a revolving electro-magnet, and succeeded in getting a decided and measurable effect. The importance of this is very great, for they have thus a means of determining the conductivity of liquid electrolytes by currents induced in the liquid without the use of electrodes and without polarisation.

Dr. GUTHRIE states that as the push on the liquid is directly proportional to the current quantity, they hope to measure the conductiveness of liquids and connect these to the conductivity of solids through the intervention of mercury. Dr. Guthrie stated that a conducting jelly made by dissolving gelatine in anhydrous glycerine at 100° was being prepared for trial.



Prof. Sylvanus Thomson then communicated five laboratory notes from University College, Bristol. The first relates to the source of sound in the Bell telephone receiver. Two theories are now being discussed as to this effect, the molar theory regards the motion of the diaphragm in mass as the source of sound, the molecular theory finds it in the molecular motions of the magnetic core of the instrument. Prof. Thomson applied his method of getting magnetic curves with iron filings dusted on gummed glass to this problem. He found that when no currents passed in the telephone, the magnetic lines springing from the pole of the magnet are gathered together on the diaphragm opposite over a central region (*a* in the figure) which is magnetised lamellarly, or like a magnetic shell. The rim of the plate beyond this region is, however, magnetised radially, the external poles *n n* being of the same name as the near pole of the magnet, and between these two zones there is a neutral circle *x x*. It was remarkable, too, that the lines of force *l l*, touching the plate, were bent back around this circle forming a kind of valley *v*. When the current passed in the coil, in a direction so as to reinforce the magnetism, the lines are gathered more closely on the central region of the plate. If the current diminishes the magnetism, the lines are, on the other hand, repelled from the plate. The neutral ring is also altered. In the first case it shrinks in size, in the second it expands. A small thick disc is wholly magnetised lamellarly; a disc entirely magnetised radially becomes slightly conical in shape. In the actual telephone the disc is flat at the middle and conical at the edges. As the neutral ring shifts, the diaphragm will assume new nodal lines. Dr. Thomson concludes that the molecular theory is not, therefore, necessary to account for the speech of the telephone, although it may assist. As confirming this view, he found that with iron rings round a cardboard diaphragm and an iron centre-piece the enunciation was good though the timbre was altered; whereas, with radial pieces of iron on the cardboard, the timbre was good but the enunciation bad. In reply to Prof. Adams, Dr. Thomson said that the stronger the magnet the smaller the lamellarly magnetised space became, and that with a thicker disc the neutral ring was not so well marked.

Dr. LODGE suggested that the best place for the coil would be in the valley over the neutral ring which was in an unstable condition. It is also worthy of remark that the lines curve round the edge of the disc and project beyond the centre region *a*.

Dr. THOMSON next wrote on a saw blade with a magnet, and dusted iron filings on it which arranged themselves so as to trace the writing. This is usually shown on a steel plate, but a saw retains the virtue for six or eight months. A modification of this experiment, due to himself, consisted in writing on the blade with one pole of a powerful battery, the other pole being connected to the end of the blade.

The third "note" recommended the use of fine steel fibres, got by breaking iron gauze of 32 meshes to the inch, instead of iron filings for exhibiting magnetic lines. The fourth note showed that the lines of force got by filings fixed on cards are magnetic, that of a bar magnet acting as a magnet. The fifth note explained that solid magnetic "figures" could be got by coating iron filings in shellac to make them light, and floating them in water; or by mixing filings in a soft paste of plaster of Paris, which could be cut into sections on hardening.

General Science.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

V.

The Otto Silent Gas Engine.

THE first practical gas engine was, it is believed, introduced by M. Lenoir, of Paris, now nearly twenty years ago. In this engine the ignition of the explosive mixture of gas and air in the cylinder was effected by the passage of an electric spark, obtained from an induction coil worked by a battery. This arrangement, although effective, had many manifest inconveniences, and M. Hugon and others improved upon the idea by effecting the ignition by means of a small gas flare placed opposite a slight aperture in the cylinder, which was opened and closed by a valve. This device has been adopted in all the engines subsequently invented, and answers the purpose most effectually.

The progress of the electric light has given an impetus to the manufacture of gas engines, and at the present time a large number are employed for the purpose of driving dynamo-electric machines.

The general appearance of the Otto and Lanjen gas engine, as manufactured by Messrs. Crossley Brothers of Manchester, is shown by the cut on the following page.

The principle of combustion in these gas engines is entirely new. In them an explosion does not take place in the ordinary meaning of the term. A small part only of the charge is combustible, which on ignition serves to expand the remainder, thus avoiding shock and effecting great economy. The engines have also the peculiarity of igniting their charges at the *beginning* of the stroke, leaving *the whole* of the stroke for effective expansion of the gases, instead of merely a fraction as in obsolete constructions.

Every part of these engines is now made to gauge,

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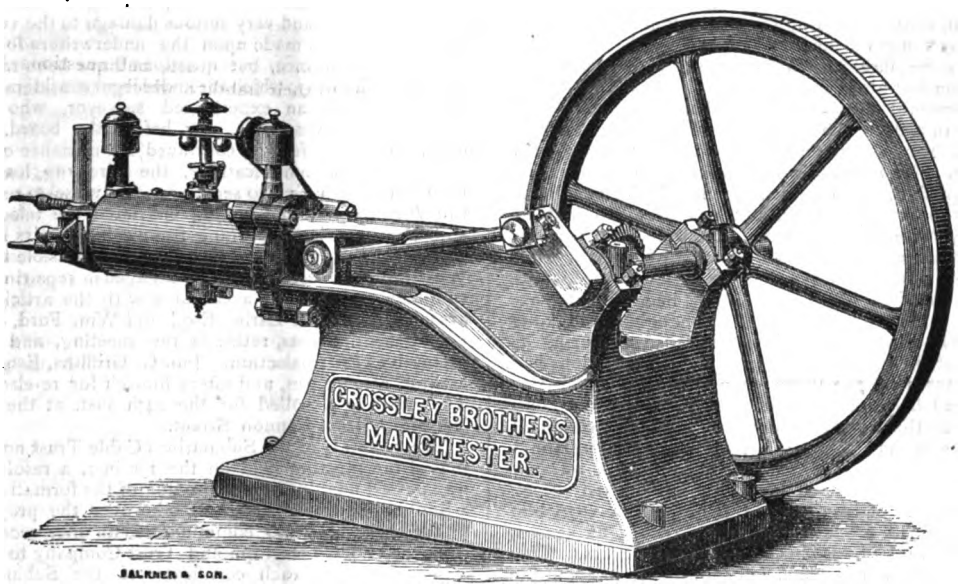
and is therefore easily replaced. The wearing portions are also of the simplest and most inexpensive patterns; for instance, the working barrel of the cylinder itself can be supplied for about 1¼ per cent. on the first cost of the engine, and being strictly to gauge, can be put in with great facility in a few hours.

By this system the engine may be kept permanently almost equal to new for a certain annual expenditure.

parts. They possess the great and sometimes indispensable advantage, as compared with steam engines, of starting at full power at once on the gas being lit, and, requiring no boiler, they avoid all the dangerous and pecuniary risks, annoyances, expensive repairs and attendance which a boiler frequently entails. The cost of a chimney, the nuisance of smoke, coal, ashes, and water must also be considered when a boiler is used. Where work is intermittent, trouble with a steam boiler and engine is at its



The pistons are of great length—of which the peculiar construction of the engine readily admits, and being also as light as possible, ride on the oil with the least degree of wear.

The slides valves keep in excellent condition with proper care; but, as far as possible, to prevent risk of stoppage even from neglect, they are supplied in duplicate with each engine without extra charge.

These engines will run with extreme smoothness and regularity of speed, and have very few working

maximum, but with a gas engine the reverse is the case.

The smallest engine capable of driving a Gramme "A" machine, is one 3½ H.-P. *nominal*, or 5¼ H.-P. *indicated*. The 8 H.-P. *nominal* will *indicate* 14 H.-P. These will drive 3 Gramme "A" machines and 2 Siemens "A" machines. The gas consumed by these engines per *indicated* H.-P. is from 21 to 23 cubic feet, the engine running at 160 revolutions per minute.

City Notes.

Old Broad Street, May 12th, 1879.

GREAT NORTHERN TELEGRAPH COMPANY.—At the annual general meeting of this company held at Copenhagen, on the 16th of April, 1879, F. Zahle, Esq., presided. The chairman, C. F. Tietgen, Esq., in his opening remarks, referred to the depressed state of trade which still continued, and which would naturally affect an undertaking like that of the company; nevertheless, it was satisfactory that the result of the year's working had been such that the revenue had been about the same as in the previous year, and that, notwithstanding a considerable amount had been credited to reserve, the directors were able to propose the payment of the same dividend as for the previous year. He then reported upon the company's business as follows:—The state of the cables in Europe had generally been satisfactory during the year 1878. At the beginning of the year, the cable between Denmark and France had been interrupted, an interruption which eventually proved to have been caused by damage done by anchors, but the repairs had been effected on the 5th March, and during the remainder of the year the cable had been working uninterruptedly. The cable between Finland and the Aland Isles had been interrupted from January 23rd to May 17th, the damage having been caused by chafing on the rocks. The cable between Denmark and Norway had been subject to an interruption, also caused by chafing on rocky bottom, but the interruption had only lasted from 2nd to 17th June. None of these interruptions had, however, caused any considerable loss to the company. According to the statistical tables there had been transmitted on the lines in Europe, during the year 1878—770,352 single telegrams, producing a revenue of 2,410,454 francs. Against, in 1877, 739,146 single telegrams, producing a revenue of 2,379,202 francs, which showed a slight increase, mainly due to the traffic on the Franco-Danish Cable, which had been much occupied during the Paris Exhibition, whilst the traffic on the other lines had suffered from the depressed state of trade.

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The former agreement with the Post Office, after having been in force for seven years, had expired in September last. After some negotiations, heads of a new agreement had been drawn up on the 15th November, and these had subsequently been approved by the Treasury. The new agreement, which would remain in force until the year 1903, contained terms somewhat more onerous than the former contract; but, on the other hand, not only would the company retain the special land-lines hitherto worked by them between Aberdeen, Newcastle and London, but an additional wire from London to Newcastle had been placed at its disposal, thus duplicating that important section of the company's circuit, and this would much contribute towards an increase in the speed of transmission. Provision had also been made for special terms in case of a general word rate tariff being introduced for European traffic. The state of the cables in the East had not been as satisfactory as that of the cables in Europe. The Wladiwostock-Nagasaki cable was interrupted at the commencement of the year from chafing on rocky ground, but had been repaired on January 13th, and had from that time been working without interruption. The Shanghai-Nagasaki cable had been interrupted five times, altogether for 26 days. The cause of all these interruptions had been damage done by ships' anchors. The Shahghai-Hongkong cable had been interrupted ten times, in all during 37 days, but the greater portion of these interruptions had been caused by the thorough overhaul to which this cable had been subject last summer. After the completion of this work the cable was in a better condition than it ever had been, and telegrams between Hongkong and Shanghai, which had formerly been retransmitted in Amoy, could now be transmitted direct. The amount of messages transmitted in 1878 had been—126,048, producing 2,677,362 francs, as against in 1877, 122,217, producing 2,780,819 francs. This decrease of revenue, which had shown itself in about the same proportion with regard to the local traffic between the ports in China and Japan, as to the European traffic, was attributable, not only to the frequent interruptions of the cables, but also to the stagnation of trade. The accounts having been passed, the retiring director, C. F. Tietgen, Esq., was re-elected, as likewise were Admiral Bille and A. Berner, Esq., as the shareholders' auditors.

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—The directors submit the accounts for the six months ending 31st December, 1878. The amount to credit of revenue is £37,052 12s. 9d., and the expenses have been £24,449 9s. 4d., leaving a balance of £12,603 3s. 5d., which, with the balance £3,391 7s. 6d. brought from last account, makes an available total of £15,994 10s. 11d., with which it is proposed to deal as follows:—First preference shares, half-year's dividend to 31st December, 1878, at 6 per cent. per annum £10,368 18s; second preference shares, half-year's dividend to 31st December, 1878, at 6 per cent. per annum £1,400 14s.; Reserve account £2,000. Balance to current half-year's account £2,224 18s. 11d. The expenses over which the directors can exercise control exhibit a small reduction, but the item of repairs to cables on account of accidents has been exceptionally heavy amounting to £3,199 16s. 3d. in excess of the corresponding half. This added to the additional expense of the ship amounts to £5,306 5s. 6d., in excess of the corresponding half-year, and precludes the directors from recommending any dividend upon the ordinary shares. During the half-year the Legislature of Jamaica, recognising the necessity of an increase to the company's revenue, granted a subsidy of £2,000 per annum for 10 years, commencing on the 1st October, 1878, and a quarter's payment of this subsidy is dealt with in the accounts. The board take this opportunity of expressing their sincere thanks to the colony for this much needed addition to the resources at their disposal, and for the appreciation evinced by this grant of the value of the company's services and the importance of securing their continuance. The directors regret to report that an accident occurred to the company's repairing ship *Investigator* on the 8th January last, owing to which she has been completely disabled. While steaming out of St. Thomas Harbour on her way to repair a cable, the port boiler exploded, causing the death of two of the crew and very serious damage to the vessel. A claim has been made upon the underwriters for the amount of insurance, but questions have been raised as to their liability, which are under legal consideration. The report of an experienced surveyor, who has examined the vessel, is now before the board. In order to provide for the continued maintenance of the intercolonial communications, the directors lost no time in endeavouring to secure another vessel to replace the *Investigator*, and having chartered the telegraph ship *Caroline*, then returning from cable repairs in the Mediterranean, she proceeded as soon as possible to the West Indies, where she is now engaged in repairing the company's cables. In accordance with the articles of association, C. W. Earle, Esq., and Wm. Ford, Esq., two of the directors, retire at this meeting, and offer themselves for re-election. Jno. G. Griffiths, Esq., the auditor, also retires, and offers himself for re-election. The meeting is called for the 14th inst. at the City Terminus Hotel Cannon Street.

The secretary of the Submarines Cable Trust notifies that at the meeting held on the 1st inst. a resolution was passed unanimously approving of the formation of a limited liability company to take over the property of the trust. He also communicates an offer received from the Globe Telegraph and Trust Company to give in exchange for each certificate of the Submarine Cables Trust, after the coupon due last month is detached, five fully paid £10 preference shares and sixty fully paid £10 ordinary shares of the Globe Company.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 55¼-55¾; Ditto, Preferred, 85-86; Ditto, Deferred, 27-27½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅜-6⅝; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10¼-10¾; Direct United States Cable, Limited, 1877, 10¾-11; Eastern, Limited, 7⅜-7⅞; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 101-104; Eastern, 6 per cent. Preference, 11⅞-12⅛; Eastern Extension, Australasian and China Limited, 7⅛-7⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-110; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10¾-11; Great Northern, 8¼-8½; Indo-European, Limited, 20½-21½; Mediterranean Extension, Limited, 2¾-3; Mediterranean Extension, 8 per cent. Preference, 9¼-9¾; Reuter's, Limited 9½-10½; Submarine, 220-230; Submarine Scrip, 1¾-2; West Coast of America, Limited, 1¼-1⅜; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference 8½-9; Ditto, ditto, Second Preference, 7¾-8¼; Western and Brazilian, Limited, 3¾-4; Ditto, 6 per cent. Debentures "A," 95-99, Ditto, ditto, ditto, "B," 88-93; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 111-114; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 30-30½; Ditto, 6 per cent. Bonds, 107-109; Ditto, Second Bonus Trust Certificates, 2¾-2¾; India Rubber Co., 10½-11.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 152.

THE INTERNATIONAL TELEGRAPH CONFERENCE.

ON Tuesday, the 10th inst., will assemble, under the auspices of the Postmaster-General, the first international telegraph conference held in England.

The adherence by Government to the international treaty or convention in force at the time it purchased the inland lines of the United Kingdom, carried with it, among other things, the obligation of providing for such conferences as the present whenever London should be selected as the place of meeting; and the fact that London has been so selected, on almost the first occasion which has arisen since, will, no doubt, be felt as a compliment to the country.

The last international telegraph conference was held in 1875, at St. Petersburg, and was attended by delegates from the telegraph administrations of the governments of Germany, Austria, and Hungary, France, Great Britain, India, Italy, Russia, Turkey, Spain, Belgium, Holland, Dutch East Indies, Roumania, Sweden, Denmark, Egypt, Norway, Switzerland, Greece, Portugal, Servia, Luxemburg, and Persia; each administration being entitled to one vote, although represented in several cases by more than one delegate. The delegates were, with few exceptions, the heads of the administrations of the contracting governments; and, in addition to the delegates, the St. Petersburg conference was well attended, as had been the previous conference at Rome, by representatives from the chief English telegraph companies, who were invited to a place at the table, to make known their views upon all questions discussed, but without the power of voting.

The procedure to be adopted is usually settled by each conference at its first or second sitting, but that followed at St. Petersburg will presumably serve generally as the model for the constitution of the London conference. There will, however, probably be more delegates than on previous occasions, as additional governments have signified their intention to take part in it, amongst which may be mentioned some of our own colonial governments, the Brazils, and perhaps Japan. The representatives from the companies are also likely to be more numerous than at St. Petersburg or Rome.

The gathering will, therefore, be an important one, and will have for task the revision of the international regulations and tariffs of nearly all the telegraph lines of the world, the only exception of consequence being the lines of America which are in the hands of private companies; but even these will be affected by the modifications which may be made, as in practice the American companies find themselves obliged to treat all messages exchanged with Europe in general accordance with international usage.

A copy of the St. Petersburg convention which the delegates have to revise is now before us. Its French text and English translation in parallel columns, occupy about 80 closely printed pages of foolscap folio, and the document is divided into three sections. The first section is in the form of a treaty, and deals chiefly with the political side or general principles of international telegraphy. Thus it recognises the right of all persons to make use of the lines, reserves on the part of each government the power of interrupting the service on its own territory, or stopping messages dangerous to public security or contrary to law, defines the order of precedence among the principal categories of messages, declares the limits of governmental liability specifies the bases for the formation and modification of tariffs, &c.

The second section is the *pièce de resistance*, containing all the working regulations necessary to give effect to the articles of the treaty and many more besides. The extent of the details embraced by it may be gathered from the fact that it deals with the size or carrying capacity of the principal wires, the kinds of instruments employed, the component parts of all the letters, figures, and signs used in signalling, the subdivision of messages, from the three treaty categories of government, service, and private, into classes of plain, secret, multiple, urgent, repeated, insured, press and telegraph cards, with the appropriate treatment and charge for each; the subsidiary arrangements for replies, official acknowledgments of receipt, the interchange of messages with ships at sea by semaphores, their re-despatch from delivery offices, to follow the addressees to different places or countries, corrections by telegraph, &c. It regulates, also, the hours of duty at the different offices, the power of diverting messages from given routes, the conditions of stopping those contrary to law, the measures to be taken on the occurrence of interruptions, the selection of an international monetary unit for the preparation of tariffs and accounts, the amount which may be collected from the public of each country as the equivalent of this unit, the adjustment of traffic accounts, the payment of balances, the re-imbursement of charges, the duties of the international office, &c.

The third section contains the international

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tariffs, arranged under the twenty-word standard for Europe, and the single-word standard for extra Europe. They are composed chiefly of one or two mean terminal rates and one or two mean transit rates for each country. They include also the charges of concessionary companies where necessary.

From the foregoing outline of the three sections, it will be recognised that the task of revising an international telegraph convention is by no means a light one, especially as each administration of the contracting Governments has the right to put forward as many proposals as it pleases for altering any of the working regulations or tariffs. The first alterations for consideration at the London conference were compiled and printed, and circulated by the international office at Berne early last year, it being then thought that the conference would be held in 1878. It was postponed till now in consequence of the unsettled state of Europe, and a book of supplementary proposals has lately been issued. The aggregate proposals fill several hundred large quarto pages and would occupy several days to read and perhaps several weeks to thoroughly study.

An international telegraph conference is however a very fair place to illustrate the doctrine of the survival of the fittest. Owing to the number of parties interested, a multitude of proposals must of necessity come before it for consideration; but from the criticism and wide experience brought to bear upon them, those which pass the ordeal, and finally emerge in the form of new regulations or rates, are generally very few. It is therefore probably safe to predict that the present convention of St. Petersburg which has worked well for upwards of three years will not be materially altered in revision, except, perhaps, in the two important matters of European tariffs and the alteration of the message standard. We understand that the German administration has strong proposals on both these points, and it is possible that the London conference may be remembered as having swept away the old twenty-word system of charging in Europe and substituted a cheap single word rate in its place.

Each conference has hitherto specially associated itself with some useful step in advance, or with the more prominent of the measures passed by it. Thus the first Paris conference of 1854 is remembered by its original well devised rules, which, so far as they go, have served as the basis of all subsequent rules. The second Paris conference of 1865 is remembered by its abolition of the plan of charging by mileage and its introduction of mean rates for each country. The Vienna conference of 1868, by its great reductions in tariffs, its creation of a ten-word message standard for extra Europe, and the establishment of an international office. The Rome conference of 1872, by its addition of a word standard to the ten-word minimum for extra Europe, its recognition of various other exceptions beyond European limits, and its provision for the leasing of lines to the press, the St. Petersburg conference of 1875, by its introduction of a word standard pure and simple for extra Europe, a mean tariff between Europe on one side and India on the other, and its creation of the telegraph card at reduced rates. Should the London conference now succeed in so far reconciling the numerous interests concerned as to give us a cheap word rate throughout Europe in place of the present twenty-word standard, its title to honourable recollection will not be inferior to that of any of its predecessors.

It is usual for a Minister of State to open each conference by a speech to the delegates, in which he welcomes them, wishes them success in their labours, and finally places them under the presidence of the head of the telegraphs of the country. Thus at Vienna, Rome, and St. Petersburg, the delegates were received respectively by Count Beust, Visconti Venosta, and General Timatieff; and then introduced to M. Brunner de Wattenwyl, Signor D'Amico, and General de Luders, the heads of the several telegraph departments, as their chairmen for the work in hand.

We heard with some regret, a short time ago, a rumour that this precedent, so long established that it has grown into a rule which the delegates would naturally expect to see observed on the present occasion, would possibly be departed from, by the retention and appointment on the part of the Post Office of a foreign official, not a delegate, to act as chairman. There can be little doubt that, following the spirit of their previous practice, the delegates, being in England, would prefer to be placed under an Englishman. We trust, therefore, that if the rumour had any foundation in fact, the intention has been abandoned. To send abroad for a chairman for meetings to be held in England would certainly seem to border somewhat on the absurd. It would, perhaps, be invidious to mention names, but in the Post Office itself, and in the large telegraph departments of the Indian Government, it is perfectly well known that there are able officers of high position, and in one instance, at least, of considerable actual experience in international conferences, whose eminent qualifications for the post of honour are undeniable.

Except for this rumour, all the arrangements appear to be well considered, and we learn with satisfaction that the Post Office, the Indo-European

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Government Telegraph Department, the English Telegraph Companies, and the Society of Telegraph Engineers are arranging to do all they can to welcome the delegates who have come to us literally from all parts of the world, and to make their stay amongst us as agreeable as possible.

Lieut.-Col. Bateman-Champain, R.E., will be a delegate for the Indian Government at the International Conference.

Major Webber, R.E., goes to the Cape on the Staff of Sir Garnet Wolseley.

MUIRHEAD'S DUPLEX SYSTEM.

By A. MUIRHEAD.

(*Continued from page* 162.)

THE artificial line or "inductive resistance" may also be formed on a plan patented by Mr. Herbert A. Taylor, and the writer in 1875, whereby the conducting strip of tinfoil in the apparatus described is replaced by a conducting leaf of plumbago paper, that is a paper made by mixing about 50 per cent. of powdered plumbago with the paper pulp, in the same way as other powders are sometimes introduced for the purpose of giving substance to paper. The order of plates in the make-up of these plumbago inductive resistances, then becomes (1), plumbago paper for the conducting part of the circuit; (2), paraffined paper for the insulator; and (3), tinfoil for the earth or inducing plates. The plumbago plates are connected in series, and the earth plates to earth, in the same way as is shewn in fig. 2. Practically, however, the contacts between these plumbago resistances are somewhat difficult to make, and the tinfoil conducting strip has been preferred.

Inductive resistances, made by first saturating silk or cotton-covered copper or other wires in melted paraffin, and then winding spirally with an external coating of gilded copper strip, such as is used in working gold lace for uniforms, has also been patented by Mr. John Muirhead, and the writer in 1875. This material is chiefly intended for use as an artificial line for duplex working on land lines; and it has been successfully applied to the duplexing of the London to Emden (Germany) line, consisting of a short cable and about 250 miles of land line. The cable part is represented in the artificial line by sections of Muirhead's artificial cable, and the land line portions by bobbins of this fine metal-coated wire. The differential method is here employed, the Morse receiver being operated through the medium of a highly sensitive relay.

In establishing the duplex balance it is found necessary to resort to certain adjusting devices in order to approximate the first part of the artificial line to the varying conditions of the first few knots of the cable. Of course, theoretically, an artificial cable made on the principle involved in the resistances is alone sufficient to establish the duplex balance in conjunction with the Wheatstone bridge or differential arrangement of apparatus; but this implies the condition that the artificial cable is exactly equivalent to the actual one, in every respect, a condition which is obviously unattainable in practice, seeing that most cables are laid in varying depths of water at various temperatures. Nevertheless, it always remains true that the nearer the artificial approximates, electrically speaking, throughout its entire length to the real cable, the less need there is for auxiliary adjustments. The writer has found, from many experiments, that some of these adjustments have considerable power, and are able to correct for a slight difference of type between the artificial line and the real one, as well as to allow of the former being curtailed by a certain number of knots, thus reducing the cost of the apparatus. Particular adjustments are also found to have particular corrective influences on the balance, and a mutual sympathy, so that the alteration of one affects another in a particular fashion. To enable the reader to understand the nature of these adjustments, I have sketched some of the most important of these in fig. 3, which represents the arrangement of apparatus for duplex working after the Wheatstone Bridge method (see fig. 1), the method which we have applied to all the cables we have duplexed.

In the diagram r_1, r_2, r_3, r_4, and r_5, Fig 3 are adjustible resistances; s is the receiving condenser, generally from 20 to 60 microfarads according to the length of the cable; s_1 is an adjustable condenser applied to the end of the receiving circuit to which the cable is attached. The other apparatus explains itself.

In order to render this paper as complete and instructive as possible, I will now give an example or two of the actual working balances established on cables by Muirhead's system; beginning with the Marseilles to Malta cable which, besides being the first long cable, is the simplest example of the balance yet obtained. At Marseilles the balance for this cable (which is 826 knots long, and crosses the Mediterranean to Bona before proceeding to Malta) consists simply of the Wheatstone balance, and Muirhead's artificial cable, having some of the final inductive plates dispensed with, and the conductor of the artificial line to earth through a resistance of 7000 units.

The Aden to Bombay cable of 1817 knots, is balanced at Aden by making $s_1 = 1{\cdot}23$ mf.; $r = 0$; $r_2 = 0$; $r_3 = 210{,}000$, at a point 250 miles down the artificial line; $r_4 =$ infinity; and $r_5 =$ infinity. The proportion of artificial to the actual line is about three to four; and the resistances in the sides of the bridge are 2000 and 2030 respectively. The total resistance of this line is 11,827 ohms, and the capacity is 656 microfarads. These two cables are worked by the Siphon Recorder, which, although an extremely sensitive instrument is really more easy to effect a duplex balance with than the mirror galvanometer. As is well known, the rapid succession of signal currents in a cable gives rise to a long slow undulation or wave of electricity in a cable, on which the individual signals ride as a series of ripples. The recorder coil is not nearly so sensitive to this slow wave as the mirror or the galvanometer, and the recorder zero is shifted less markedly than that of the mirror. In mirror reading the movement of the zero is very apt to confound itself with the signals themselves, because the light spot moves always in one straight line up and down the scale, whereas in recording, the

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FIG.4.

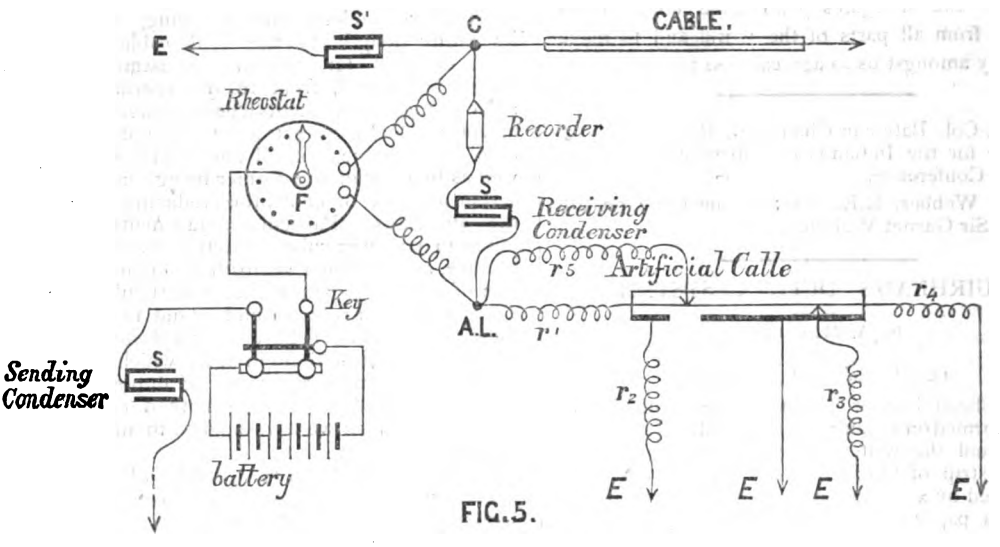

FIG.5.

FIG. 6.

FIG. 6A.

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displacement of the zero is transverse to the direction of the signals along the paper "slip." And further, on the mirror the signals are fleeting and present themselves to the eye for a moment only; whereas by the recorder the signals are permanently written and can be deciphered at leisure. For these reasons the duplex balance with the mirror galvanometer requires to be more perfect and requires a larger amount of artificial line than in the case of the recorder.

The longest cable yet duplexed by our system, is the Direct United States Atlantic cable from Ballinskelligs Bay in Ireland, to Torbay in Nova Scotia, a length of about 2,423 knots, and on this cable, the mirror galvanometer is the receiving instrument employed. It is the first Atlantic cable to which the duplex system of working was applied. The total resistance of this cable is 7,315 Siemens' units, and the total capacity 987·6 microfarads. At Ballinskelligs, the balance is effected by making $r_1 = 22$, $r_2 =$ 1,400 S.U., $r_3 =$ 10,000, $r_4 =$ 1,600, S.U., $r_5 =$ infinity, $s_1 =$ 0·06 mf., $s =$ 60 mf., the cable branch of the Wheatstone balance being = 2,000 ohms, and the artificial line side = 2,036 ohms.

At Torbay, the balance is got by making $r_1 =$,0 $r_2 =$ S.50., $r_3 =$ 5,000 at 1,600 knots down the line, $r_4 =$ infinity, $r_5 =$ 90,000, $s_1 =$ 4·37 mf., $s =$ 60 mf.; the cable branch of the Wheatstone balance being 2,000, while the artificial line side is 2,010.

With these adjustments, the proportion of capacity in the artificial line, to that of the actual cable, is as 4 to 5. The speed of signalling obtained on the Direct United States cable when working duplex, is 100 letters per minute each way, making a total of 45 letter words per minute. Experience, indeed, proves that the duplex system of working submarine cables practically doubles their carrying capacity; since the time formerly lost in switching over from "send" to "receive," and back again from "receive" to "send," is all saved. On the other hand, duplex reading on the mirror is very fatiguing work to the clerk, for his eyes require to follow the spot incessantly, whereas, in "simplex" working, he can get a relief from reading in the act of sending a message.

The following woodcuts are fac-similes of the signals received at Aden and Bombay respectively on the duplex system, through the new Aden-Bombay cable, at the rate of eighteen words per minute, the ordinary speed of working of that cable.

Muirhead's duplex system was, as I have before mentioned, first experimentally tried on the Marseilles-Bona cable, in July, 1875. In February, 1876, it was adapted to the Marseilles-Malta cable; in April, of the same year it was applied to the Suez-Aden, or Red Sea cable, and in January of the following year to the Aden-Bombay cable. All these cables belong to the Eastern Telegraph Company, and it is the duty as well as the pleasure of the writer to state here that the early success attending the application of duplex to cables is largely attributable to the encouragement so freely given by the managing director of the Company, Sir James Anderson, who, as a reward, has secured to his Company the benefit of having their cables worked on the duplex method several years before any other company.

THE INDUCTION BALANCE AND SONOMETER.

By PROF. D. E. HUGHES.*

IMMEDIATELY upon the announcement of Arago's discovery of the influence of rotating plates of metal upon a magnetic needle (1824), and Faraday's important discovery of voltaic and magneto-induction (1831), it became evident that the induced currents, circulating in a metallic mass, might be so acted upon either by voltaic or induced currents as to bring some new light to bear on the molecular construction of metallic bodies.

The question was particularly studied by Babbage, Sir John Herschel, and by M. Dové † who constructed an induction balance, wherein two separate induction coils, each having its primary and secondary coils, were joined together in such a manner that the induced current in one coil was made to neutralise the induced current in the opposite coil, thus forming an induction balance, to which he gave the name of differential inductor. In those days physicists did not possess the exquisitely sensitive galvanometers and other means of research that we possess to-day, but sufficiently important results were obtained to prove that a vast field of research would be opened if a perfect induction balance could be found, together with a means of correctly estimating the results obtained. In experimenting with the microphone I had ample occasion to appreciate the exquisite sensitiveness of the telephone to minute induced currents. This led me to study the question of induction by aid of the telephone and microphone. The results of those researches have been already published.‡

Continuing this line of inquiry, I thought I might again attempt to investigate the molecular construction of metals and alloys, and with this object I have obtained, after numerous comparative failures, a perfect induction balance, which is not only exquisitely sensitive and exact, but allows us to obtain direct comparative measures of the force or disturbances produced by the introduction of any metal or conductor.

The instrument which I have the honour to present to the Royal Society this evening, consists, 1st, of new induction currents balance; 2nd, microphone, with a clock as a source of sound; 3rd, electric sonometer, or absolute sound measurer, a late invention of my own; 4th, a receiving telephone and three elements of Daniells' battery.

[Fig. 1 represents the induction balance and sonometer with its auxiliary apparatus as shown at the society, s^2 being the balance; s^1 the sonometer; M the microphone, and clock C; B, the battery; G, a galvanoscope; and T, the telephone: t_1 and t_2 are terminals. Figs. 2 and 3 give the same arrangement in theory.]

In order to have a perfect induction currents balance suitable for physical research, all its coils as well as the size and amount of wire, should be equal. The primary, c, c_1, and secondary coils,

* Paper read before the Royal Society, May 15th.

† De la Rive, "Treatise on Electricity," vol. i, chap. v. London, 1853.

‡ "Comptes Rendus," December 30, 1878, and January 20, 1879; Society of Telegraph Engineers, March 15, 1879.

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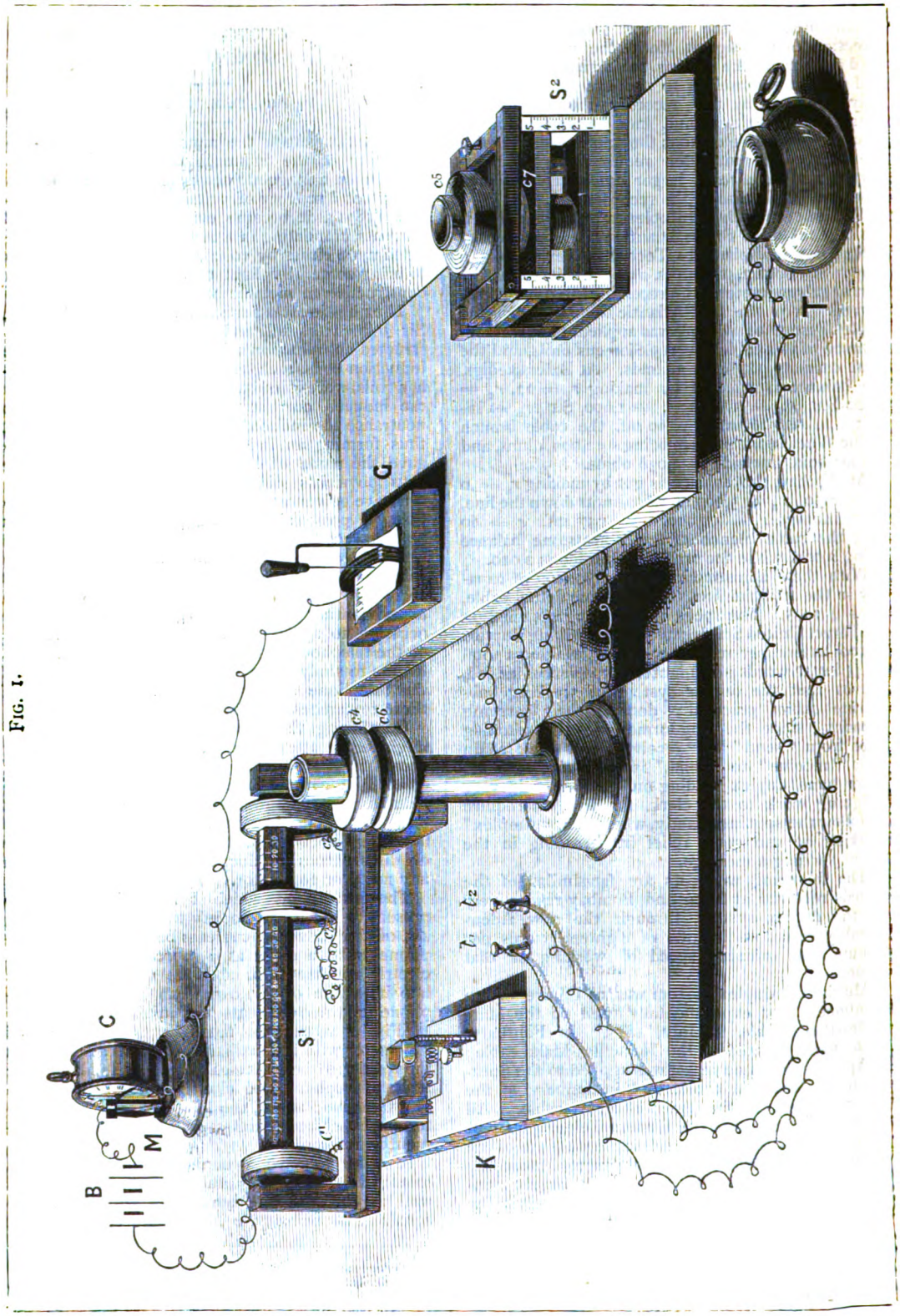

FIG. 1.

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c_4, c_5, should be separate and not superposed. The exterior diameter of the coils presented this evening is 5½ centims., having an interior vacant circular space of 3½ centims., the depth of this flat coil or spool is 7 millims.

Upon this box-wood spool are wound 100 metres of No 32 silk-covered copper wire. I use four of such coils, formed into two pairs, the secondary coil, c_4 or c_5, being fixed permanently, or by means of an adjustable slide, at a distance of 5 millims. from its primary c_6 or c_7; on the second similar pair there is a fine micrometer screw, allowing me to adjust the balance to the degree of perfection required.

These two pairs of coils should be placed at a distance not less than 1 metre from each other, so that no disturbing cause should exist from their proximity.

The two primary coils are joined in series to the battery, the circuit also passing through the microphone.

In place of the telephone I have sometimes used a magnetic pendulum, the swing or the arc described indicating and measuring the forces. * I am at present engaged upon a very sensitive voltameter which shall indicate and measure the force of rapid induced currents. The telephone, however, is well adapted as an indicator, but not as a measurer of the forces brought into action. For this reason I have joined to this instrument an instrument to which I have given the name of electric sonometer S^1, fig. 1. This consists of three coils, c_1, c_4, c_2, fig. 3, similar to those already described, two of which c_1, c_2, are placed horizontally at a fixed distance of 40 centims. apart, and the communication with the battery is so arranged that there are similar but opposing poles in each coil; between these there is a coil, c_3, which can be moved on a marked sliding scale divided into millimetres; in a line with these two opposing primary coils, the centre coil is the secondary one, and connected by means of a circuit changing key K, with the telephone T, in place of the induction balance. If this secondary coil is near either primary coil, we hear loud tones, due to its proximity. The same effect takes place if the secondary coil is near the opposing coil, except that the induced current is now in a contrary direction, as a similar pole of the primary acts now on the opposite side of the induction coil; the consequence is, that as we withdraw it from one coil approaching the other, we must pass a line of absolute zero, where no current whatever can be induced, owing to the absolute equal forces acting equally on both sides of the induction coil. This point is in the exact centre between the two coils, no matter how near or distant they may be. We thus possess a sonometer having an absolute zero of sound; each degree that it is moved is accompanied by its relative degree of increase; and this measure may be expressed in the degrees of the millimetres passed through, or by the square of the distances in accordance with the curve of electro-magnetic action.

If we place in the coils of the induction balance, or$_5$, a piece of metal, say copper, bismuth, or iron, we at once produce a disturbance of the balance, and it will give out sounds more or less intense on the telephone according to the mass, or if of similar sizes, according to the molecular structure of the metal. The volume and intensity of sound is invariably the same for a similar metal. If by means of the switching key K the telephone is instantly transferred to the sonometer, and if its coil be at zero, we should hear sounds when the key is up or in connection with the induction balance, and no sounds or silence when the key is down or in connection with the sonometer. If the sonometer coil was moved through several degrees, or through more than the required amount, we should find that the sounds increase when the key is depressed; but when the coil is moved to a degree where there is absolute equality, if key is up or down, then the degree on scale should give the true value of the disturbance produced in the induction balance; and this is so exact that if we put, say a silver coin whose value is 115°, no other degree will produce equality. Once knowing, therefore, the value of any metal or alloy, it is not necessary to know in advance what the metal is, for if its equality is 115°, it is silver coin; if 52, iron; if 40, lead; if 10, bismuth; and as there is a very wide limit between each metal, the reading of the value of each is very rapid, a few seconds sufficing to give the exact sound value of any metal or alloy.

During the course of these experiments with this instrument I noticed that my own hearing powers varied very much with state of health, weather, &c., that different individuals had wide differences of hearing, and that nearly in all cases one ear was more sensitive than the other; thus whilst my degree of hearing was 10°, another might be 60° in one ear and 15° in the other.*

Dr. Richardson, F.R.S., who upon my invitation investigated this subject, became so impressed with the value of the instrument as an absolute measure of our hearing powers, and its capabilities of throwing much light upon its relation with health, that he has undertaken a series of researches which will extend over some time, and which I think from some facts already gained will be of great value to the medical profession. These experiments are now in his very able hands, and he will in due time announce the results to the Royal Society.

If an observer's hearing is limited to 10°, how can we hear results below this line? I should have stated that when used to measure the hearing power, we determine on a constant standard of force such as one element Daniell, but if we increase the number of elements we in the same ratio increase the inductive disturbance, and thus by a large increase of force bring within our range results too feeble to be heard without its aid, the sonometer constantly, however, giving the same degree for equality as the increased force is also used on this instrument. Thus in our measurements we can entirely neglect the amount of battery, as its comparative results remain a constant.

As a rule three Daniell elements will be found quite sufficient, and even this weak force is so exquisitely sensitive that it will find out the smallest fraction of difference in weight or structure

* "Telegraphic Journal," December 15, 1878.

* To this portion of my instrument when used as a measurer of our hearing powers, we have given the name of audiometer.

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of metals. Thus two silver coins such as a shilling, both quite new, and both apparently of the same weight, will be found to possess a difference of weight which the instrument at once indicates.

The following experiments will show its exceeding sensitiveness and its wide field of usefulness as an instrument of research.

I. If we introduce into one pair of the induction coils any conducting body, such as silver, copper, iron, &c., there are set up in these bodies electric currents which react both upon the primary and secondary coils, producing extra currents whose force will be proportional to the mass, and to its specific conducting powers. A milligramme of copper on a fine iron wire, finer than the human hair, can be loudly heard and appreciated by direct measurement, and its exact value ascertained. We can thus weigh to an almost infinitesimal degree the mass of the metal under examination; for instance, if we take two English shilling pieces fresh from the Mint, and if they are absolutely identical in form, weight, and material, they will be completely balanced by placing one each in the two

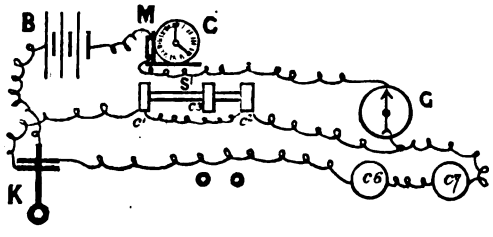

FIG. 2. PRIMARY CIRCUIT.

separate coils, provided that or these experiments there is an adjustable resting place in each pair of coils, so that each coin may lie exactly in the centre of the vacant space between the primary and secondary coils. If, however, these shillings are in the slightest degree worn, or have a different temperature, we at once perceive this difference, and if desired, measure it by the sonometer, or, by lifting the supposed heaviest coin at a slight distance from the fixed centre line, the amount of degrees that the heaviest coin is withdrawn will show its relative mass or weight as compared with the lightest. I have thus been able to appreciate the difference caused by simply rubbing the shilling between the fingers, or the difference of temperature by simply breathing near the coils, and in order to reduce this sensibility within reasonable limits, I have only used in the following experiments 100 metres of copper wire to each coil and 3 cells of battery.

II. The comparative disturbing value of discs of different metals, all of the same size and form as an English shilling, and measured in millimetre degrees, by the sonometer, is the following :—

Silver (chemically pure)	125	Iron (chemically pure)	45
Gold " "	117	Copper (antimony alloy)	40
Silver (coin)	115	Lead	38
Aluminium	112	Antimony	35
Copper	100	Mercury	30
Zinc	80	Sulphur (iron alloy)	20
Bronze	76	Bismuth	10
Tin	74	Zinc (antimony alloy)	6
Iron (ordinary)	52	Spongy gold (pure)	3
German silver	50	Carbon (gas)	2

These numbers do not agree entirely with any list of electrical conductivity I have yet met with; the numbers are, however, invariably given by the sonometer, and the divergence may be due to some peculiarity of structure of the metals when formed into discs. Future investigations with this instrument will, no doubt, give more correct values than I have been able to obtain with my limited means of research.

III. It will be seen from the above, that the

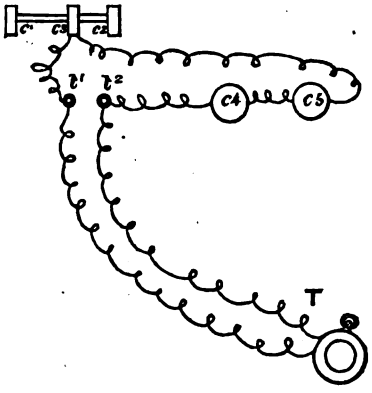

FIG. 3. SECONDARY CIRCUIT.

instrument gives very different values for different metals or alloys, consequently, we cannot obtain a balance by employing two discs of different metals, and the instrument is so sensitive to any variation in mass or matter, that it instantly detects the difference by clear loud tones on the telephone. If I place two gold sovereigns of equal weight and value, one in each coil, there is complete silence, indicating identity, or equality between them; but if one of them is a false sovereign, or even gold of a different alloy, the fact is instantly detected by the electrical balance being disturbed. The instrument thus becomes a rapid and perfect coin detector, and can assay any alloy, giving instantly its electrical value. The exceeding sensitiveness of this electrical test I shall demonstrate by experiment.

Again, as regards coins, it resolves an almost magical problem. Thus, if a person puts one or several coins into one pair of coils, the amount or nominal value being unknown to myself, I have only to introduce into the opposite coils, different coins

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successively, as I should weights in a scale, and when perfect balance is announced by the silence, the amount in one box will not only be the same nominal value but of the same kind of coin.

IV. We find by direct experiment with this instrument, that the preceding results are due to electric currents, induced by the primary coil, and that it is by the reaction of these that the balance is destroyed, for, if we take an insulated spiral disc or helix of copper wire, with its terminal wires open, there is no disturbance of the balance whatever, notwithstanding that we have introduced a comparatively large amount of copper wire; but on closing the circuit, the balance is at once very powerfully disturbed.

If the spiral is a flat one, resembling a disc of metal, and circuit closed, we find that loud tones result when the spiral is placed flat, or when its wire is parallel to those on coils; but if it is held at right angles to these wires, no sound whatever is heard, and the balance remains perfect. The same thing occurs with discs of all non-magnetic metals, and a disc of metal placed perpendicular to the coils exerts no influence whatever. The contrary result takes place with a spiral of iron wire or disc of iron, the induced current circulating in the spiral is at its maximum when the spiral lies flat or parallel with the coils, giving no induced current whatever when at right angles; but the disturbances of the induction balance are more than fourfold when perpendicular to the wires of the coils than when parallel with the same. That this result is simply due to the property of magnetic bodies of conduction of magnetism, we shall see in some following experiments.

That the currents in non-magnetic metals travel in a circle corresponding to that of the primary coil, may be seen with spongy gold. In its first extremely divided state it falls below our zero of hearing; on slightly shaking the bottle we have 2° as its value; on pressing it its value rapidly increases with the pressure, until, when formed into a solid disc, its value becomes 117°.

V. The instrument proves that a very remarkable difference exists in bars of iron of the same exact form and size, but of different provenance or treated in a different manner; in point of fact, no two bars, cut off the same rod, and treated alike, are exactly of the same value, or induce a complete balance.

Mr. Stroh, the eminent instrument maker, has kindly furnished me with numerous samples, varying in value in degrees of the sonometer from 100 to 160.

Chemically pure iron was found to be the best, but still very slightly superior to ordinary iron which had been drawn into a wire of the required thickness; the fibrous condition thus developed being highly favourable (if softened by heat) for the conduction of magnetism. From numerous examples I select a few indicative values :—

	Softened.	Tempered.
Chemically pure iron ...	160	130
Forged soft iron	150	125
Wire-drawn iron	156	120
Cast steel	120	100

(To be continued.)

NEW ELECTRIC LAMPS AT THE ALBERT HALL.

THE most interesting of the novel electric lamps displayed at the Albert Hall during the recent exhibition of Electric Lighting Apparatus was, perhaps, the single carbon lamp of Dr. C. Siemens. Dr. Siemens appears to have been the first to see that the negative carbon wasted away by reason of its incandescent state, and not by the tearing action of the current itself. It, therefore, occurred to him to substitute a metallic electrode for the negative carbon; and the better to preserve it from disintegration, he provided that it should be kept cool by the circulation of cold water in its interior. A rudimentary form of this lamp, it may be remembered, was shewn by Dr. Tyndall, in his lecture on the Electric Light last January, at the Royal Institution. The pattern exhibited at the Albert Hall was a far more developed form, the negative electrode consisting of a copper pipe bent into a peak below the upper positive carbon. Cold water was kept flowing in this pipe by an hydraulic arrangement, and the motion of the carbon, which was of the shape of a large disc, was regulated by wheel-work. Even this ingenious model is, however, only a step to a more perfect one, which we hope to describe in detail when it is completed.

A lamp in which the two carbons were in the form of opposed discs, their motions being regulated by a modified Serrin regulator, also deserves mention. It was exhibited by Messrs. Crompton and Fawkes, of Queen Victoria Street.

THE PYRAMID LAMP.

This lamp, the invention of Mr. W. Blanch Brain, managing partner of the Trafalgar Colliery, Forest of Dean, is specially designed for illuminating collieries, harbours, and large sheds. For colliery purposes an electric lamp requires to be as simple as possible, and no shadow should be thrown by any part of the apparatus on the illuminated field below. In designing his lamp, therefore, Mr. Brain sought to produce one which would, when placed high, shed down a pyramid of unobstructed light; the relationship of the lit surface to the square of the height suggesting the name of the lamp. As will be seen from the accompanying illustration there is no basement to the lamp, the arc being at the lowest point, where the three carbons meet. The arc is formed between the vertical carbon and the point of junction of the two horizontal carbons. For this purpose, the vertical carbon is withdrawn to a limited distance, by the current when it is put on. The contact between the two horizontal electrodes becomes highly incandescent, and both of these carbons are worn down to fine pencil points which glow with a white heat. A curved metal reflector is supported over the arc to throw the light down. The vertical carbon, which is the positive electrode, is lifted up, so as to establish the arc by means of the electro-magnet, seen in the middle of the lamp. This electro-magnet consists of three coils, an upper and two lower. The lower pair are hinged at the outsides, and their inner poles are made of soft iron pieces hollowed out, so as to allow the vertical carbon to pass freely between when the current is off. In this case the vertical carbon drops down

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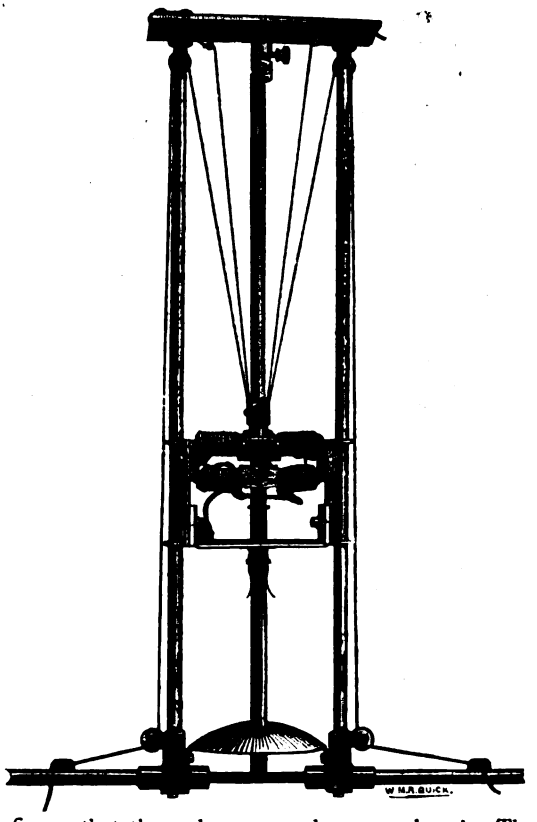
and rests upon the two horizontal ones. When, however, the current is put on the lamp, it traverses all three coils of the electro-magnet, and the two lower or hinged coils being thereby attracted towards the upper one, they clutch the vertical carbon and lift it up with them to the adjusted length of the arc. This length is adjusted by an oblique washer and screw, after the manner employed in the Wallace-Farmer lamp, *see* TELEGRAPHIC JOURNAL for November 1st, 1878.

metre. If a contact-breaker be introduced into the circuit, the lamp can be extinguished and re-lighted some hundreds of times per minute without any discernible periods of darkness; a feature which engineers engaged in pile-driving in the bed of a rapid river will duly appreciate. When the length of the arc becomes too great it is reset, as in the Wallace-Farmer lamp, the re-setting recurring at stated intervals of twelve or fifteen minutes, as may be determined by the size of the



It will be seen from the figure that the carbons are pulled together by means of cords; but it is noteworthy that the weight which actuates them is the electro-magnetic adjusting apparatus itself. Several advantages are claimed for this lamp: for example, the positive carbon is free to move through the middle of the lamp when no current is on, and hence as long a carbon as is desired may be employed; that shewn in the Albert Hall being one

carbons employed. The economy of the lamp is also in its favour, since it can be sold for £6 10s., and there need be little or no waste of carbon, for even small points can be consumed by inserting them in holders, which take the place of longer rods. The invention was patented December 14, 1878, and it has been successfully introduced into the Trafalgar Works, and on the Bathurst Wharf, Bristol.

(To be continued.)

ORME'S ELECTRIC LAMP.

WITH a view to obviate the use of clockwork in electric lamps and to insure a steady movement of the carbons, Mr. Orme has constructed the regulator illustrated by the figures on the following page.

The negative carbon (which should be twice the diameter of the positive) is placed in the upper socket and screwed in tightly. The positive carbon is placed between the two wheels below, which hold it in a line perpendicular with the negative carbon.

Beneath the stand is an electro-magnet, the lower arm of which is movable and capable of being attracted to the upper arm. A connecting rod passes from the lower arm of the magnet, up the tube, which supports the lower carbon, to a ratchet wheel at the side of and on the same axle as the larger wheel, which is thus capable of being revolved by the up and down motion of the lower arm of the magnet. There is a small spring on the left hand side of the ratchet wheel, which prevents this wheel from being carried back by the pressure of the rod as it

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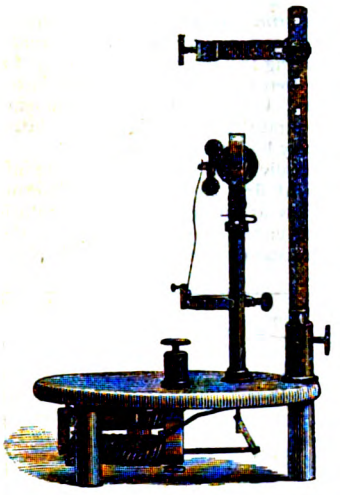
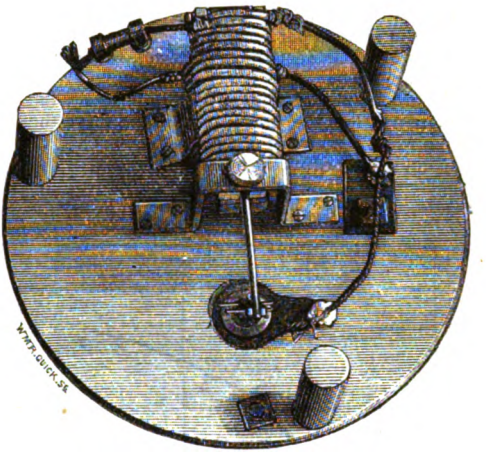
rises, and, yet, by the arrangement of a second small spring, allows of a slight backward movement for the purpose of forming the electric arc between the carbons.

The second figure shows the connections beneath the stand.

When the lamp is connected to a battery or other source of electricity, the positive current passes from the binding screw of the magnet round the magnet, up the tube and positive carbon to the negative carbon, which should touch the lower one, and so back through the upper carbon support and terminal at its foot, to the battery. Immediately the circuit is complete, the lower arm of the magnet is attracted and held tightly to the upper arm, but in its passage it moves the connecting rods, which push back the wheel, and thus separate the carbons to the desired extent of the arc. When the positive carbon is burnt away, so that the circuit is broken, the lower arm of the magnet falls, thus turning the ratchet wheel and bringing the carbons again into contact.

The advantage of this system is that any length of carbon may be employed, a hole being made in the stand so that the positive carbon may pass through; the lamp is always ready for action and is controlled entirely by the current, and as the negative carbon burns away but very slowly compared to the positive, the arc practically remains in one position. Messrs. Jackson and Co., of the Barbican, are the agents for the sale of these lamps.





ON ELECTRIC LIGHTING.

By Dr. JOHN HOPKINSON, F.R.S., M. Inst. M.E.

(*Continued from page* 170.)

PRELIMINARY to experiments on the current, determinations of resistances were made. The resistance of each brass coil was first determined, to afford the means of calculating the value of c in any subsequent experiment. When the ten are coupled in parallel circuit, the calculated resistance was 0·29 ohm, whilst 0.292 was obtained by direct measurement. The leading wire was then examined; the further ends being disconnected, the insulation resistance was found to be over 60,000 ohms; how much over it was immaterial to learn. When the ends of the cable were connected the resistance was found to be 0·129 ohm. The resistances in the machine were found to be as follows when cold: magnet coils 0·156 and 0·152 respectively, armature coil 0·324; total 0·632. Direct examination was made of the whole machine in eight positions of the commutator, giving 0·643 ohm, with a maximum variation from the mean of 0·6 per cent. After running the machine for some time the resistance was found to be 0·683, an increase which would be accounted for by a rise of temperature of 12° C. or thereabouts. The resistance of the calorimeter is 0·20, without its leading wire, which may be taken as 0·01. We have then in circuit three resistances which must be considered: (1) the resistance of the machine and leading wire, assumed throughout as 0·81, denoted by c_1; (2) the resistance of the brass coils c, calculated from the several determinations, with the addition of the resistance of the leading wire 0·02, and denoted by c_2; (3) when present, the resistance of the calorimeter and leading wire denoted by c_3.

Two approximate corrections were employed, and should be detailed. The first is the correction for the considerable heating of the resistance coils c. These were arranged in two sets of five each, five being in parallel circuit, and the two sets in series. The current from the machine, being about 7·4 Webers in each wire, was passed for three or four minutes; the circuit was then broken, and the resistance c_2 was determined within one second of breaking circuit, when it was found to be about 5 per cent. greater than when cold. As the resistance was falling, the following was adopted as a rule of correction: square the current in a single

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wire, and increase the resistance c_3 by $\frac{1}{10}$th per cent. for every unit in the square. The second correction is due to the fact that the calorimeter was losing heat all the time it was being used. It was assumed that it loses 0·01° C. per minute for every 1° C. by which the temperature of the calorimeter exceeds that of the air; this correction is of course based on the experiment already mentioned.

The method of calculation may now be explained:—

R is the total resistance of the circuit, equal to $c_1 + c_2 + c_3$;

Q is the current passing in Webers;

E the electromotive force round the circuit in Volts;

W_1 the work per second converted into heat in the circuit, as determined by the galvanometer, measured in ergtens per second;

W_2 is the work per second as determined by the calorimeter;

W_3 is the work per second as determined by the dynamometer, less the power required to drive the machine when the circuit is open;

HP is the equivalent of W_3 in horse-power;

n is the number of revolutions per minute of the armature.

Then:

$$Q = \frac{9}{8} \times \frac{a + b}{b} \times \frac{1}{e_2},$$

$$E = QR,$$

$$W_1 = EQ,$$

also $W_2 = \frac{R}{0{\cdot}2}$ multiplied by the mechanical equivalent of the heat generated per second in the calorimeter.

The accompanying table gives the results of the experiments. A power 0·21 ergtens, or 0·28 horse-power, was required to drive the machine at 720 revolutions on open circuit. An examination of the table shows that the efficiency of the machine is about 90 per cent., exclusive of friction. Comparing experiments 11 and 13, and also the last four experiments, it is seen that the electromotive force is proportional to the speed of rotation within the errors of observation. Experiments 14, 15, and 16 were intended to ascertain the effect of displacing the commutator brushes.

The principal object of the experiments was to ascertain how the electromotive force depended on the current. This relation is represented by the curve of fig. 4, in which the abscissæ represent the currents flowing, or the values of Q in the table, and the ordinates the electromotive forces, or the values of E reduced to a speed of 720 revolutions per minute. The curve may also be taken to represent the intensity of the magnetic field. It will be remarked that there is a point of inflection in the curve near the origin. The experiments 1 to 5 indicate that this is the true form of the curve, and it is confirmed in a remarkable manner by a special experiment. A resistance intermediate between 5½ and 4 was used in circuit, and E and Q were determined in two different ways: first, by starting with an open circuit, which was then closed; secondly, by starting with a portion of the resistance short-circuited, and a very powerful current passing, and then breaking the short circuit. It was found that E and Q were four times as great in the latter case as in the former. Unfortunately the numbers are not sufficiently accurate to be given, as the solutions of the standard battery had become mixed.

The curve really gives a great deal more information than appears at first sight. It will determine what current will flow at any given speed of rotation of the machine, and under any conditions of the circuit, whether of resistances or of opposed electromotive

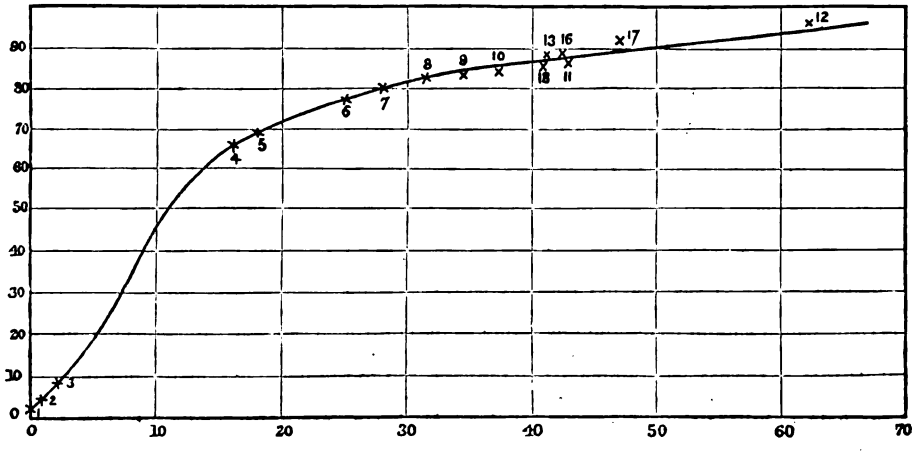

FIG. 4.

forces. It will also give very approximate indications of the corresponding curve for other machines of the same configuration, but in which the number of times the wire passes round the electromagnet or the armature is different.

It will be well to compare these results with those obtained by others. M. Mascart worked on a Gramme machine with comparatively low currents: he represents his results approximately by the formula

$$E = n(a + bQ),$$

where a and b are constants. This corresponds to the rapidly rising part of the curve of Fig. 4. Mr. Trowbridge with a Siemens machine obtained a maximum efficiency of 76 per cent., and states the machine was running below its normal velocity. Mr. Schwendler's results when fully published, will probably be found to be the most complete and most accurate existing. In the *précis* he states that the loss of power with a Siemens machine in producing currents of over 20 Webers is 12 per cent. Now taking the author's experiments 4 to 19, the mean value of W_1 is 3·027 and of W_3 3·304: adding to the latter 0·21, the power required to drive the machine when no current passes, it appears that 13·8 per cent. of the power applied is wasted. Again, taking experiments 4, 6, 8, 10 and 12, the mean value

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of W_2 is 2·888 and of W_3 3·076, indicating a waste of power amounting to 12 per cent. Of this, as already stated, 0·28 horse-power is accounted for by friction of the journals and commutator brush; the remainder is expended in local currents, or by loss of kinetic energy of current when sparks occur at the commutator.

The author has not yet tried any quantitative experiments with the electric light, but hopes shortly to do so. In the meantime he would remark that, as the lamp is usually adjusted, only half the energy of the current appears in the arc, or 44 per cent. of the energy transmitted to the machine by the strap.

In conclusion the author would express the obligation he is under to Messrs. Chance Brothers and Co. on account of the facilities he has enjoyed for making these experiments at their works. It may be mentioned that one principal object of the research of which this is a beginning is to obtain a minute knowledge of the electric light, with a view to lighthouse illumination.

TABLE I.

No. of Experiment.	R	Q	E	W_1	W_2	W_3	H.-P.	n	Position of Commutator Brush.
1.	1025	0·0027	2·72	.....	.....	.....	.....	720	Original position, as supplied from maker.
2.	8·3	0·48	3·95	0·0019	.....	.....	.....	"	
3.	5·33	1·45	7·73	0·0112	.....	0·042	0·056	"	
4.	4·07	16·8	68·4	1·149	1·140	1·179	1·59	"	
5.	3·88	18·2	70·6	1·285	.....	1·263	1·68	"	
6.	3·205	24·8	79·5	1·972	2·158	2·106	2·81	"	
7.	3·025	26·8	81·1	2·174	.....	2·392	3·19	"	
8.	2·62	32·2	84·4	2·718	2·888	2·780	3·71	"	
9.	2·43	34·5	83·8	2·894	.....	3·370	4·49	"	
10.	2·28	37·1	84·6	3·138	2·903	3·538	4·72	"	
11.	2·08	42·0	87·4	3·671	.....	3·960	5·28	"	
12.	1·345	64·0	86·1	5·510	5·349	5·777	7·70	654	(Strap slipping.)
13.	2·08	41·1	85·5	3·514	.....	3·790	5·05	698	
14.	2·07	36·0	74·5	2·682	.....	2·852	3·80	696	13° extra lead of brush.
15.	2·09	42·7	89·2	3·809	.....	4·233	5·64	708	8° less lead of brush than in original position.
16.	2·09	41·7	87·2	3·636	.....	4·135	5·51	713	5°
17.	2·10	45·0	94·5	4·252	.....	4·810	6·41	759	5°
18.	2·08	40·8	84·9	3·464	.....	4·010	5·35	696	5°
19.	2·06	35·1	72·3	2·538	.....	2·672	3·56	586	5°

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—With reference to your leading article on "The New Theory of Terrestrial Magnetism," of Professors Ayrton and Perry, in the number of your Journal for May 1st, allow me to call attention to the views which I have published in a memoir on "The Polar Auroras," presented to the *Academie des Sciences*, and dated March 13th, 1876.

After having endeavoured to prove that the aurora was due to a flow of positive electricity directed towards the void of planetary space and not towards the sun, across the mists and frost clouds of the polar regions, I added:—

"Whatever may be the origin of this polar electricity, it must be admitted that it comes from the equator and the tropical regions. But it might be objected that the electrified clouds would become discharged during their progress, and in effect we know that storms become more and more rare as we approach the poles. My former experiments, and others still unpublished,* having led me to suppose that the celestial bodies are charged positively, the only kind of electricity, perhaps, which exists, I should be induced to regard *the earth itself as charged with positive electricity* which develops itself from the sun and seas by a process of simple emission, and spreading over the whole of its surface at the poles as at the equator, produces in the atmosphere very different effects in consequence of the completely opposite meteorological conditions of these regions." (*Comptes Rendus*, vol. lxxxii. p. 626, March, 1876. *Philosophical Magazine*, June, 1876.)

In my complete memoir on the polar aurora, of which the *Comptes Rendus* has only given an extract, but the manuscript of which, in the archives of the *Academie*, presented and dated 13th March, 1876, can be consulted, and of which I have reproduced the chief points in my work, *Recherches sur l'Electricite*† (pages 236 and 241), the following passage occurs:—

"The positive electricity thus emanating from the terrestrial globe would not be, according to us, the result of a production or generation properly so called, produced by physical or chemical causes. *It would not be due to evaporation, nor to friction, nor to thermo-electric actions, but would proceed from an original charge or store of electricity, proper to the earth itself*, transported by it, since the time of its formation, and which tended to dissipate itself, like the heat which it possesses, with extreme slowness, by reason of its considerable mass.

"This electricity, penetrating the atmosphere, would extend to the higher and more rarified strata of the air, which offer immense conducting spaces, and would spread itself over the planetary regions. The lower strata of air near the earth not being rari-

* These experiments were published a short time after in a note which I have presented to the *Academie*, dated the 10th April, 1876, and in which I considered equally the sun as having a charge or store of electricity. This note concludes as follows:—

"Thus the sun does not create the electricity which it possesses, any more than the heat and the light which are the transformation of it; *it is a store* which it has received from the nebulous ring of which it is only a particular brilliant, destined to disappear some day. This nebulous ring proceeds from another electric wave, and so on, up to the first cause, the creator of all force and of every movement. Regarded from this point of view, the incandescence of the solar globe, prolonged during a long series of ages, is itself only a spark of short duration in the infinity of time and space." (*Comptes Rendus*, vol. lxxxiii. p. 816, April, 1876.)

† Paris: Fourneau, 18, Rue de la Sorbonne, 1879.

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fied, we can understand that the positive electricity will be present only in minute quantities, and accumulated in the higher layers. Thus the increase of the quantity of positive electricity in proportion to the elevation of the locality can be explained.

* * * *

"The considerations which consequently arise, agree besides, up to a certain point with the hypothesis of Ampère, admitting the existence of an electric current in a determined direction, enveloping the globe and producing its magnetic action.

"It may be added, in order to explain the emission of the electricity in the atmosphere and, consequently, in space, that this should be a current of very high tension, not merely maintained in a certain thickness of the earth's crust as in a conductor of a limited thickness, but spreading around the whole of the mass of the globe, *by reason of its high tension*."

Having already had occasion to appreciate the spirit of impartiality which exists in the editing of your journal (for you have spontaneously drawn attention in a preceding volume of your journal to the fact that I had first described under the name *d'eclairs en chapelet* a remarkable form of lightning of which some examples have been observed in England), I have ventured to hope that you would allow me to make in your columns the remarks which I have the honour to address to you.

Accept, sir, the assurance, etc.,

GASTON PLANTÉ.

SIR,—It would be a satisfaction to many of your subscribers if you could inform them through the TELEGRAPHIC JOURNAL who has been selected to represent Great Britain at the forthcoming International Telegraph Conference to be held in London in June next. You would remove from the minds of English telegraphers the humiliating thought that they are behind other nations, if so be you can announce that this time our Government has not been obliged to send to Hanover for a man to represent England among the delegates of all nations.

Yours, etc.,

May 14th, 1879. ENQUIRER.

[Your other suggestion has for some time been entertained by us, and may be realised in due time.—ED. T. J.]

THE DUPLEX SYSTEM ON CABLES.

SIR,—I have read in your and other journals accounts of the lecture (which I had also the pleasure of hearing) recently delivered by Mr. Preece on the subject of Duplex Telegraphy before the Society of Arts.

As it appears to me that an incorrect impression is likely to arise from certain statements of the lecturer, I beg to forward you for publication a copy of a letter I have sent to Mr. Preece,

And remain, Sir, yours faithfully,

J. MUIRHEAD, JUNR.

29, Regency Street, Westminster, S.W. *May* 28, 1879.

"DEAR SIR,—I was much surprised to hear you say in your lecture on Monday evening before the Society of Arts that, although I 'had duplexed some of the cables of the Eastern Telegraph Company in the Mediterranean and Red Sea on Mr. Stearns' principle, Mr. Stearns had only recently succeeded in duplexing one of the Anglo-American Company's Atlantic Cables.'

"The inferences naturally drawn from this statement are, first, that in duplexing the Mediterranean and Red Sea cables I had either infringed Mr. Stearns' patents or used them with his consent. Secondly, that I had not duplexed any one of the Atlantic cables, or any of the long cables east of the Red Sea.

"Now it is within your knowledge that I absolutely deny using any of Mr. Stearns' patents, and that for years past I have challenged that gentleman to take legal steps to decide and enforce his claims, but he has not thought fit to accept the challenge, or take any action in the matter.

"It is, I think, also known to you that besides duplexing several cables of the Eastern Telegraph Company in the Mediterranean and in the Red Sea, I have successfully duplexed the following long submarine cables:—

"Suez to Aden	1,500 miles	in 1876.
"Aden to Bombay ...	1,800 „	„ 1877.
"The Direct United States Cable, being the longest cable in existence	2,400 „	„ 1878.
"Madras to Penang ...	1,300 „	„ 1878.

"&c.

"Altogether my system has been applied and was in use upon upwards of 10,000 miles of cable before Mr. Stearns had succeeded in his long protracted efforts to establish duplex on an Atlantic or other long line.

"The method I adopt is distinctly described in my patents and has frequently been fully explained in the scientific and other journals, whereas, we are not yet informed of the means Mr. Stearns has recently employed to duplex one of the Atlantic cables; and it will be obvious to any disinterested electrician, who compares my specifications with those of Mr. Stearns, that I use no part of his inventions, as specified in his patents, but an apparatus, the novelty of which is not, and cannot be, disputed.

"You stated also in your lecture that Mr. Stearns had succeeded in obtaining twenty-five words per minute on the Anglo-American cable (1,800 miles). If you will be good enough to refer to the TELEGRAPHIC JOURNAL of May 15th, 1878, you will find it recorded that upon the Direct United States Cable (six hundred miles longer than the Anglo-American) I obtained a speed of twenty-five words per minute. Now our sending twenty-five words per minute on a cable 2,400 miles long is practically the same thing as sending about forty words per minute on the shorter cable 1,800 miles long.

"I do not ask you to accept my unsupported statement as to the essential difference between mine and Mr. Stearns' system. Sir William Thomson, Mr. Varley, Professor Jenkin, Mr. Latimer Clark, Professor Ayrton and others of the highest authority in the telegraphic world, have given their opinion that my method is quite distinct from what Mr. Stearns claims by his patents.

"Having regard to these well-known facts, I think I have some ground of complaint (as well on my own account as on that of my friends associated with me in the matter) in that you should have omitted to mention in your lecture upon the subject of duplex telegraphy the important work we had accomplished long before Mr. Stearns was able to duplex the only long cable he has ever been successful with, viz., the Anglo-American, and that you should have, in face of the high authorities I have cited to the contrary, stated as a fact that I had used Mr. Stearns' inventions.

"I trust you will do me the justice to read this communication at your next lecture, in order that some of the misapprehensions created on the last occasion may be removed.

"I also request the favour of this letter being published with your lecture in the proceedings of the Society.

"I am, dear Sir, yours faithfully,

"J. MUIRHEAD, JUNR.

"W. H. Preece, Esq.,

"General Post Office, E.C.

"16 *May*, 1879."

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Notes.

THE ELECTRIC LIGHT.—Mr. George Livesey, C.E., engineer to the S. Metropolitan Gas Company, in his evidence before the Parliamentary Committee, stated that in his opinion the gas companies should not be allowed to undertake the business of electric lighting as they did not possess the necessary plant, and because it would divert them from their proper business of supplying gas. This objection did not apply to corporations supplying gas. As an engineer he admitted that the electric light was suitable as an illuminating agent, and thought that facilities should be given for its introduction.

MR. FARRAR, of the Board of Trade, said the success of the light for lighthouses was assured, and we should soon have it at all the salient points of the coast. It is already established at the South Foreland, at Sutor Point between Newcastle and Shields, and at the Lizard. The fishermen on the north coast were overwhelmingly in favour of the light; the captain of the Ostend mail boat had complained that it was so dazzling he could not properly see before him. On that account it might be dangerous for vessels to use it at sea. The electric light in a lighthouse would cost rather more than double the outlay upon an oil lamp.

MR. LISTER, engineer in chief to the Mersey Docks and Harbour Board at Liverpool, said in their new dock works, the electric light was better than anything else; and that it would be of greater value to the port at Liverpool on the dockhead in order to allow large vessels to enter harbour by night.

MR. SAMUEL HUNTER, engineer of the Salford Corporation Gas Department, argued against private enterprise being allowed to compete with corporations in electric lighting.

MR. DEACON, borough engineer of Liverpool, referring to Mr. Preece's evidence to the effect that electric lighting conductors could not be laid beside telegraph wires under streets, said that the latter wires were rarely laid on both sides of a street, and that the electric lighting wires could be laid along the unoccupied side.

SIR WILLIAM THOMSON was of opinion that the electric light should be placed as high as possible—say 60 or 80 feet—for outdoor illumination. He anticipated a great future for it and its use in every case where a fixed light is required, whether in large or small rooms, and in lobbies or other places in private houses. He believed also that electricity would be largely used in future as a motive power.

THE ELECTRIC LIGHT AND VISION.—Professor Cohn, of Breslau, finds that letters, spots, and colours, are better perceived through the medium of the electric light than by gas or daylight. The sensation of yellow was increased 60-fold compared to daylight, of red 6-fold, and of green and blue 2-fold. He concludes that the electric light is to be preferred for distant signals to any other.

THE ELECTRIC LIGHT ON THE EMBANKMENT.—A joint report was recently presented to the Metropolitan Board of Works by Sir Joseph Bazalgette, engineer, and Mr. Keates, consulting chemist, with reference to the lighting of the Thames Embankment by electricity. After giving details as to the motive power and other matters relating to the electric machines used, the report entered into a comparison of the cost of electric light as compared with gas. In opal globes the electric light was equal to 155 candles, and in frosted globes to 265 candles. The cost of the electric light was 5·78d. per hour, and to produce a light equivalent in gas would cost in opal globes 2d. per hour, and in frosted globes 3·50d. per hour. In conclusion, the report added: —"There can be no doubt that electric lighting has now established itself as a light which, under particular circumstances of street lighting, or lighting of great interiors, railway stations, or similar places, will be used, but at present there are defects connected with it that must prevent its adoption as a general mode of lighting competing with gas. There is, in our opinion, no prospect at present of any such general competition."

THE illumination of Messrs. Crocker's drapery establishment by Jablochkoff's candles has proved very satisfactory. A 20-light Gramme machine, driven by a Tangye's horizontal high-pressure single cylinder steam engine of 16 horse-power, and 20 burners suspended from various parts of the room, complete the apparatus required. As the premises will not require to be lit electrically during the summer months, everything will be packed and covered until next autumn, when Messrs. Crocker will be ready to use it a moment's notice.

A contract between the Minister of Beaux Arts and the Societe Generale d'Electricite has been signed for lighting the "Salon," or annual Exhibition of Pictures, and also the whole of the Palais de l'Industrie. Two hundred and forty lights will be fitted up in that establishment. This result is due to the success which has attended the lighting up by the Jablochkoff system of the "Ecole des Beaux Arts," which is under the management of the same ministry, and where 24 Jablochkoff candles are burning.

THE Lord Mayor will receive the delegates of the International Telegraph Conference and the members of the International Literary Congress at dinner at the Mansion House on Thursday, June 12. Among the foreign guests expected are M. Victor Hugo, Senor Castelar, Senor Mandes-Léal, M. Jules Simon, M. Ivan Tourgueneff, M. Edmond About, Signor Macchi, Dr. Kalisch, besides a representative number of distinguished English literary men.

THE SPHYGMOPHONE.—While experimenting with the audiometer, it occurred to Dr. B. W. Richardson that he might get a secondary or telephonic sound from the movements of the pulse at the wrist. He effected this in a very simple manner, by adding a microphone to a Pond's sphygmograph. He mounts on a slip of talc a thin plate of platinum and places the talc slip in the sphygmograph as if about to take a tracing of the pulse. He connects one terminal from a Leclanché's cell to the slip of platinum on the talc, and the second terminal from the cell to a terminal of the telephone. Then he connects the other terminal of the telephone with the metal rod of the sphygmograph which supports the talc. The instrument is now ready for use. It is placed on the pulse, in the ordinary way, and is adjusted, with the writing needle thrown back, until a good pulsating movement of the needle is secured. When the movement is in full action, the needle is thrown over to touch the platinum plate, which it traverses with each pulse-movement, and completes the connexion between the telephone and the battery. The needle, in passing over the metallic plate, causes a distinct series of sounds from the telephone, which correspond with the movements of the pulse. When all is neatly adjusted, the sounds heard are three in number, one long sound and two short, corresponding to the systolic push, the arterial recoil, and the valvular check. The sounds are singular, as

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resembling the two words, "bother it." The sounds can be made very loud by increasing the battery power. This little instrument is not so good a recorder of the pulse as the sphygmograph, but it may be made very useful in a class, for illustrating to a large number of students, at one time, the movements of the natural pulse, and the variations which occur in disease.

City Notes.

Old Broad Street, May 28th, 1879.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The report of the directors of this Company for the half-year ended December 31st, 1878, states "The revenue for this period amounted to £65,096 15s. 11d.; the working expenses to £14,364 19s. 11d., leaving a balance of £50,731 16s. 0d.; to this is added £5,675 11s. 3d. brought forward from the year ended 30th June, 1878, making a total of £56,407 7s. 3d. After deducting Income Tax, £605 10s. 6d., there remains a balance of £55,801 16s. 9d. First and second interim dividends amounting to £32,500 have been distributed, leaving the sum of £23,301 16s. 9d. to be carried forward. The directors have the pleasure to report that the dispute with the Western and Brazilian Telegraph Company as to the division of traffic receipts, which was referred to at the last general meeting, has been adjusted. The several sections of the Company's cable continue in good working order." In a table of receipts appended we find the total for 1875 amounted to £129,395, for 1876, £130,938, for 1877, £132,702, and for 1878, £134,616. The reserve fund is £172,516 9s. 2d. At the meeting held on May 22nd at the Cannon Street Hotel, the Chairman (the Right Hon. Viscount Monck) in moving the adoption of the report said "that with regard to the receipts there had been a net increase of £655 over that of the corresponding half of last year; while both in London and at the various stations of the Company there had been a decrease in the working expenses. The meeting was one at which they only laid a statement of the affairs of the Company on the table, and no other business had to be transacted." Sir Thomas Fairbairn, Bart., seconded the motion, which was agreed to. The meeting terminated by a vote of thanks to the Chairman.

REUTER'S TELEGRAM COMPANY.—The report of the directors for the year ended 31st December last states that the net profits for this period, after payment of current charges and deducting rebate on unexpired subscription and bad debts, amount to £5,627, including £205 brought forward from the last account. The usual interim dividend of 2½ per cent. was paid in October last, and the directors now declare a further dividend of eight shillings per share, equal to 5 per cent., free of income tax, making a total distribution of 7½ per cent. for the year, and leaving a balance of £113 to be carried forward.

EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH COMPANY.—The directors are prepared to receive subscriptions for £450,000 part of £640,000, in £100 debentures to be issued at par, carrying 5 per cent. interest. The debentures are primarily secured by a subsidy of £32,400 per annum granted by the Governments of New South Wales and Victoria, under a contract with the Company, dated May 6, 1879, while the general revenue of the Company is also liable for the payment of interest and principal *pari passu*, with the debentures previously issued amounting altogether to £320,000. The debentures will be either "registered" or to "bearer," at the option of the alottee.

The following are the latest quotations of telegraphs:—Anglo-American, Limited, 55¾-56¼; Ditto, Preferred, 85-86; Ditto, Deferred, 27¾-28¼; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 8¼-8¾; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10½-11; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Eastern, Limited, 7⅛-7⅜; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11¾-12; Eastern Extension, Australasian and China Limited, 7⅛-7⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; German Union Telegraph and Trust, 7½-8; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 10⅞-11⅛; Great Northern, 8⅛-8½; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited 9½-10½; Submarine, 220-230; Submarine Scrip, 1⅞-2⅛; West Coast of America, Limited, 1½-1¾; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference 8-8½; Ditto, ditto, Second Preference, 7½-7¾; Western and Brazilian, Limited, 3⅜-3⅝; Ditto, 6 per cent. Debentures "A," 95-99, Ditto, ditto, ditto, "B," 88-93; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 112-116; Ditto, 6 per cent. Sterling Bonds, 103-105; Telegraph Construction and Maintenance, Limited, 30½-30¾; Ditto, 6 per cent. Bonds, 107-109; Ditto, Second Bonus Trust Certificates, 2⅜-2½; India Rubber Co., 11¼-11½; Ditto, 6 per cent. Debenture, 104-106.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,810.
	£	£	£	£	£	£	£	£	£	£	£	£	£
April, 1879 ...	45,540	12,885	3,000	803	15,180	37,846	21,060	16,299	... ...	10,195	4,225	10,526	5,183
April, 1878 ...	42,520	10,367	2,940	746	10,000	32,210	21,753	19,463	... ...	9,543	2,125	9,511	5,319
Increase	3,020	2,518	60	157	5,180	5,636	... ...	... ...	... ...	652	2,100	1,015	... ...
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	693	3,166	... ...	... ...	... ...	... ...	136

Receipts for March of "The West Coast of America Company," were £3,700 against £3,425 in the corresponding month of last year.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 153.

A TAX ON BRAINS.

A GREAT deal has been talked and written of late years on the decadence of English manufactures, and the successful manner in which foreign competition is coping with our trade. Of all nations, the Americans are our greatest rivals in the production of articles for which our markets have long been considered the best. One has only to walk up a London street, or visit an industrial exhibition, to see that America is rapidly taking the lead in all mechanical inventions applied to common life, and especially in those minor contrivances which husband time and save labour in the thousand and one operations of civilised society.

Strikes between master and man, idleness born of former prosperity, and other more universal causes, have been cited to account for this degeneration of our business with the world at large; but there is one which is, we think, more important than any of these, and which has the merit, at least, of being conspicuous and tangible, we mean the monstrous encumbrance on invention and enterprise which takes the form of the British Patent Law. Giant Blunderbore was never so great a curse to the region which he overshadowed with his club, than this blind and cruel statute is to the practical intelligence of our country. This, if anything, is the poisonous Upas tree beneath which our national invention droops and dies.

"An open career to talent," was a motto of the great Napoleon which the Americans, happily free from hereditary burdens, have sedulously kept in view; and in the United States an original thought, whatever it be worth, is free to grow to its full maturity. A patent there costs only twenty-five dollars. In England, on the contrary, it would seem almost a crime to give birth to a new idea. A man is fined twenty shillings here if he knocks down his neighbour; but if he invent a new machine, and own to the offence, he incurs a penalty of twenty-five pounds. If he persists in claiming it for more than three years, he is made to pay fifty more, and if for more than seven, nothing less than £100 will satisfy the ire, or rather the rapacity of the law. It is a strange circumstance that a man in whom nature has implanted the power to benefit his fellowmen, while improving his own condition, should be severely taxed for his efforts to exert it. We do not complain so strongly at these later exactions, although they are shamefully excessive, because if an invention is successful, they are likely to be small compared to the profits accruing from it; but, that a man should have to pay £25 for the possession of his own idea during the first six months, is to our minds a violence both to his welfare and that of the general public. It is not lack of inventive genius on our part that enables American inventors to outstrip us in the race; we are too heavily handicapped compared with them; that is all.

If a poor but intelligent English mechanic has the misfortune to conceive an improvement in some machine brought under his eye (and, as ill-luck will have it, he is just the man to have this fatal gift), his peace of mind is from that moment gone, and his life becomes a source of misery to him. He is naturally anxious to benefit himself and his children by the idea which has occurred to him; but he cannot do this unless he patents it. For that he requires £25, and he does not possess half that sum in the world. Distracted between hope, ambition, fear, and doubt, his tranquillity is destroyed. He bethinks him of some eminent man who understands these things and possesses capital: so he waits upon the great man humbly, and represents his case. Then should humiliation and neglect not end in a rebuff, and, should the great man generously take up his project and advance money for the patent, on consideration of a share in the profits, we find him left in a condition little better than before: for, if his plan should fail after all, or prove to have been anticipated by the same or a better device, his proper pride is mortified to think that he has caused another person to lose money over his own mistake; and he feels with shame that he was unable to pay for and develope his own invention himself. Painful to an independent spirit, and crushing to genius, our present patent law is a degrading incubus to progress, and, in this mechanical age, a disgrace to any civilised country.

No effort must be spared to get rid of the onerous conditions of our present patent system; and we observed with pleasure that an influential deputation, including Sir William Thomson, Dr. Siemens, and Mr. Spottiswoode, recently waited on the Chief Commissioner of Patents on behalf of the new Patent Bill. Much good might also be effected by a Government Commission to enquire into the matter, and bring all the evils of the existing regutions into the light of day: for we are convinced that they have only to be fully known to our legislators to insure an easier and better law. The revenue would suffer little from such a change, for the increased number of patents would probably make up for the reduced charge on each. Not only our trade but our inventors themselves are leaving our shores, and with them departs a portion of our national prosperity and fame.

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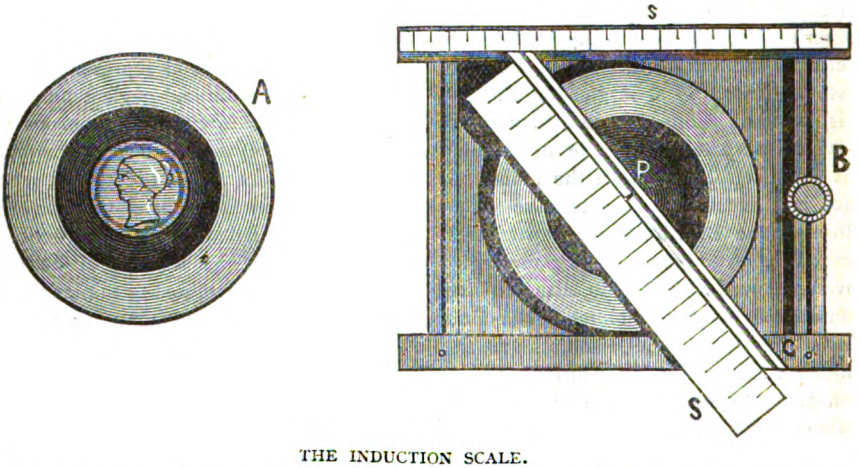
ASSAYING BY INDUCTION.

IN describing his new induction balance to the Royal Society (see TELEGRAPHIC JOURNAL for June 1), Prof. Hughes demonstrated its extreme delicacy as a means of assay for metals; and Mr. Chandler Roberts, F.R.S., the chemist to the Mint, has been much employed of late in testing its capacities in this direction as a measurer of the proportions of alloy in coins. In order to assist Mr. Roberts in his determinations, Prof. Hughes has introduced a novel mode of using the balance, which gives the instrument a great range of sensitiveness, and renders it capable of detecting one part of alloy in, at least, ten thousand parts of basic metal, a delicacy which far exceeds any known process of chemical analysis.

This modification of the balance will be readily understood by anyone who has read an account of the latter, by referring to the accompanying figure, where A represents the pair of coils, or induction pan, of the balance on which the coin to be assayed is placed, as shown, and B the other pair of coils, framed round for steadiness, and fitted with a scale for measuring the disturbing effect on the balance of the coin placed in A. Formerly, the disturbing effect of a coin placed in A, was obtained by rapidly transferring the telephone from the secondary circuit of the balance to the secondary circuit of a sonometer, and adjusting the sonometer until it gave a disturbance which to the ear seemed equal in loudness to the disturbance caused by the coin on the balance. The reading of the sonometer was then taken as a measure of the induction value of the coin. An improvement on this method consisted in comparing each coin with a standard placed in the other pan of the balance B, and estimating the *difference* between them by means of the sonometer in the same way. But it is obvious that both of these methods are inferior to one which does not trust to the discriminating capacity of the ear, but which, like the Wheatstone bridge test of resistance, depends upon getting a balance or zero of sound.

This balance is got by means of a sliding scale of metal S, which is moved across the top of the measuring pan of the balance B. There are two elements in this scale which determine its power to produce a balance, namely, its width and its thickness. The width of metal appears to balance the intensity of the induction currents produced in the disturbing coin; and the thickness their quantity; but as the intensity is the same for all coins, only the width requires to be varied. The scale is, therefore, made of a uniform width a little over half the diameter of the coils; but it increases in thickness at a regular rate per unit of length, so as to give a mass-gradient. It is composed of zinc, which is a homogeneous, and not readily rusted metal, intermediate in inductive properties between copper above and bismuth below; and for measuring the whole series of metals, the thickness is made to increase at the rate of 1 millimetre in 5 centimetres length. It will be seen, however, that by taking a scale in which the slope of thickness is flatter, say 1 millimetre in 50 centimetres length, a much higher degree of sensibility will be obtained in the balance. Such a scale would be requisite for assays of fine gold-silver alloys.

A straight guide G, is used to fix the direction of the scale as it is slid across the top of the coils in B. But it is found that every differently shaped coin or piece of metal requires a different position of this guide, that is of the path of the scale, in order that the scale may balance the disturbing piece, and a perfect zero of sound be got at all. For example, that path of the scale which enables it to balance a shilling, will not allow it to balance sixpence. For this it is necessary to shift the guide G so that the scale will then slide over a smaller segment of the coils beneath. Indeed, the width of this segment bears a proportion to the diameter of the coin. Only similar coins can thus be directly compared without altering the position of the sliding scale; but it does not take many moments to find by experiment a new position of the guide which gives an absolute zero for another coin; and, once found, this position is always known, since the guide which turns round its end G, is furnished with a fixed scale *s*, which determines its position. It should here be mentioned that the sketch merely shows the first experimental form of the apparatus, and that the finished instrument will have more precise means of measurement. A coin can be assayed by this arrangement in less than a minute. It is simply placed in the pan A, and the scale S is slid to and fro with one hand till no sound is heard in the telephone held to



THE INDUCTION SCALE.

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the ear by the other hand. This zero point can be very correctly found, for a millimetre or two to either side is sufficient to cause a faint sound in the telephone. When the zero is got, the scale is read off at the index P, and the value obtained is an assay of the coin. Tables of the proportion of alloy in coins corresponding to these readings can in this way be prepared for immediate reference, and thus a sure, delicate, rapid, and clean mode of assay is provided. It is worthy of remark, too, that, unlike the chemical balance, there is here no interference from mechanical friction, and the induction balance preserves its sensibility whether the mass experimented upon be comparatively large or minute. To show how wide is its range of efficiency, even with the ordinary scale, we give the readings for equal discs of different metals: gold 163, silver 203, copper 115, aluminium 134, zinc 68, bismuth 24. One of these instruments is, we believe, being made for the Mint.

ON THE ORIGIN OF SOUNDS IN THE TELEPHONE.

By COUNT DU MONCEL.

THE experiments of MM. Spottiswoode, Warwick, Rosetti, Canestrelli, Saul Roy, Millar, Lloyd, &c., and above all, those of M. Ader, have fully demonstrated that speech can be reproduced by a magnetic core simply enveloped by an electro-magnetic helix; but in most of these experiments the transmitter has been a speaking microphone actuated by a more or less powerful battery. Therefore, it may be said that if so strong a battery is necessary to produce these articulate sounds, the feeble currents from a Bell transmitter would be inadequate to do so. Hence these experiments do not completely demonstrate my explanation of the source of telephonic sounds, and it is necessary that speech should be produced from the feeble Bell telephone currents themselves. The experiments I have made to this end are quite conclusive. For transmitter I took a small ebonite telephone, made by M. Breguet, and for receiver the little apparatus I described to the Academy, on March 17th, 1879. It consists in a fragment of watch spring fixed on a piece of pine plank and enveloped, where it meets the plank, in a small helix of very fine No. 32 wire. This piece of spring, which projected beyond the bobbin by about 2 centimetres, was strongly magnetised, and when the helix was connected in circuit with the telephone, it sufficed to hold the plank against the ear to hear the words spoken to the telephone in a distinct manner. The reproduction was certainly somewhat feeble, and it was necessary to talk as loud as one talks to a phonograph, but the repetition of the words was very distinct; and it was clear that the sounds were not mechanically transmitted, for if both line wires were connected to the same end of the helix, no sound was heard. It is, therefore, certain that induced currents, generated by a Bell telephone, can reproduce speech in a magnetic plate surrounded by a helix, without any diaphragm influenced by that plate. I am more than ever convinced that the speech of an ordinary Bell receiver is only the result of molecular effects in the diaphragm due to magnetisations and demagnetisations caused by variations in the magnetic state of the core. If we hear better with a telephone having a diaphragm, it is because the latter, serving as an armature, exalts *(sur-excite)* the magnetic power of the core, and because it finds itself affected by the vibrations of the telephone case fixed to one of the ends of that core. M. the Abbé de Laborde has also demonstrated this last effect in a very ingenious manner, by showing that a diaphragm, made of any non-magnetic substance whatever, transmits sounds, whatever its position with respect to the magnetic core, provided there is contact between it and the case of the telephone, and he has likewise found that an iron diaphragm at a distance from the core reproduces sounds in the same manner as any other diaphragm in the same position. Only when in the neighbourhood of the core were the sounds reproduced with much greater force, precisely because of the greater energy then communicated to the magnetic system. Nevertheless, it cannot be said that the resultant vibrations of electro-magnetic attractions cannot be produced in a telephone; but it is in this case necessary that the transmitted currents are intense enough to determine these attractions, and it is impossible for me to admit that an electric current, which, according to M. Galileo Ferraris, is no stronger than the current of a Daniell cell in traversing a telegraph line capable of going round the earth 290 times, can have the power to provoke electro-magnetic attractions able to cause the complex vibrations which constitute speech. I believe, therefore, that the theory which I have mooted in my note of March 24th, 1878, is now completely demonstrated.

AN ELECTRICAL WATER LEVEL INDICATOR.

AMONGST the objects exhibited at the recent *soirée* of the Institute of Civil Engineers, held at South Kensington, the Electrical Water Level Indicator, belonging to the Nottingham Waterworks Company, and designed and constructed in the engineering department of the Postal Telegraphs, excited much interest. The apparatus exhibited consisted of a "Transmitter" and a "Receiver," the latter being in connection with a transmitter fixed at one of the reservoirs of the Company referred to, at Nottingham. During the course of the evening the visitors had thus the opportunity of seeing the actual working of the apparatus, and of observing the changes in the level of the water in the reservoir at Nottingham. Apart from the ingenuity of the invention, the apparatus exhibited was a masterpiece of constructive finish, and did extreme credit to the Postal Telegraph mechanicians. The principal part of the apparatus is the "transmitter," by means of which, on the rising of the float attached to it, a *momentary* contact is made, which causes a positive current to be sent to line at every inch of rise, and a momentary negative current at every inch of fall of the float. The importance of arranging the apparatus to make *momentary* contacts only is evident, otherwise, from the slow rise and fall of the water level, the series of currents would be continued ones which would soon exhaust the battery.

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The method by which the object in view is obtained is shown by fig. 1, which represents the arrangement of the "transmitter." *f* is a small metal disc, having a quarter of its circumference faced with a projection of platinum *b*; this projecting piece makes contact, when the disc is turned, with either the spring *d'* or *d''*, the ends of the latter being faced with platinum to insure good contact being made.

The disc *f* is fixed to an axis, to which is also attached the weight W; on the axis is a pinion, into which the wheel A gears.

Behind wheel A is a second wheel A' (shown by the dotted line); this wheel has a pin *p'*, which works in the slot S cut in the front wheel A; the length of this slot is such that if we suppose the pin to be at one end of the slot, and the wheel A' to be held in that position, then a rotatory movement of the wheel A, sufficient to move the other end of the slot up to the pin, will cause the disc *f* and the weight W connected to it to make a complete revolution, that is to say, the weight W will have been turned in the direction of one or other of the arrows according as A is turned in one direction or the other, and when it has made a complete revolution, together with the disc *f*, then the latter will have made contact with both the springs *d'* and *d''* in succession.

Fixed to the face of the disc *f* is a pin *p*. This

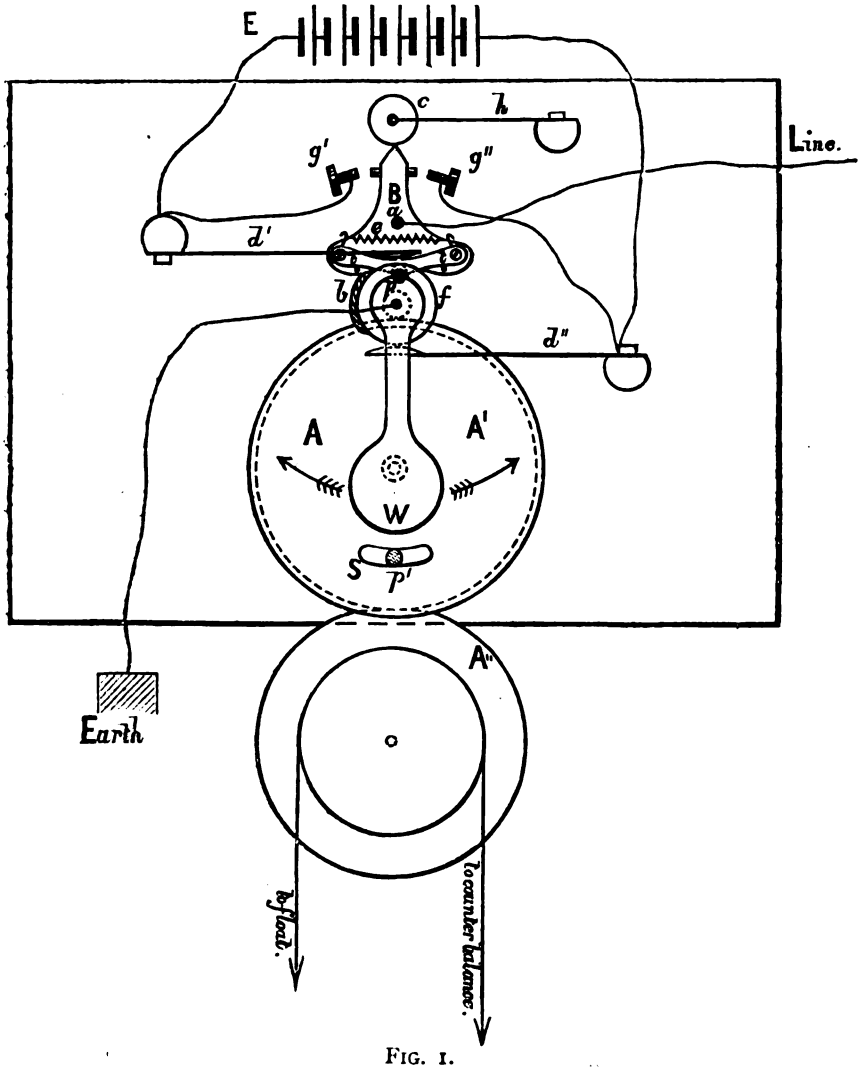

FIG. 1.

pin, when the apparatus is in the position shown in the figure, lies between two pawls *t t*, attached to the triangular piece B, which rocks on a centre *a*. The pawls are maintained in the position shown, relative to the piece B, by a small spiral spring *e*, which draws them down against small stop pins fixed on B.

The whole rocking piece can be thrown over against either of the contact screws *g'* or *g''*, and

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when against either of them will be held firmly there by the little wheel *c*, which presses, by means of a spring *h*, against either one side or the other of the pointed top of B.

The wheel A″ which gears into A′ is connected to the float by means of a chain, and the whole arrangement of the gearing is such that an inch rise of the float can turn the disc *f* through a complete revolution.

The electrical connections are those shown, the line being connected to the rocking piece B, which is insulated from the rest of the apparatus.

To understand the working of the arrangement, let us suppose that all the parts of the apparatus stand in the position shown, when the float stands at an exact inch mark. Let us suppose the water commences *rising*; for the first half inch of rise then, the wheel A′ will have been turned so as to bring the pin *p*′ to the left hand end of the slot; as the wheel A′ then continues to rotate it now turns the wheel A and rotates the disc *f*, and also moves the weight W, in the direction of the right hand arrow. The rotation of the disc causes the pin *p* to push against

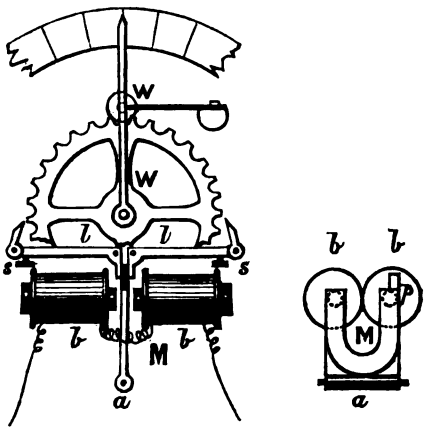

FIG. 2.

the left hand pawl of the rocking piece B, and to move the latter over towards the contact screw *g*″. After a certain angular movement of B has taken place, the action of the spring C carries it completely over to *g*″, and in this position the pin *p* clears the left hand pawl. Supposing, now, the rotation to be continued so that the lever of the weight W is at right angles to the position shown, then the platinum projection *b* will be making contact with the spring *d*″; but this will not cause any current to pass out to line, since in this position both line and earth (which is connected to the frame of the apparatus) are both connected to one pole of the battery, whilst the other pole of the latter is free. On continuing the rotation, however, the weight W arrives at the vertical position, which completes the inch movement of the float, and then topples over to the left making contact in its fall, by means of *b*, with the spring *d*′; at the moment when this takes place zinc is to earth through the spring *d*′ and the projection *b*, and copper is to line through *g*″ and B, consequently a positive current is sent to line. When the weight has completed its descent the whole arrangement resumes the position shown.

The pin *p*, it may be observed, in passing the right hand pawl, when the weight is falling, merely lifts it up and passes under it without affecting the position of B; in fact, as long as the rotation of *f* takes place in the direction just indicated, B will remain over against *g*″.

Inasmuch as *f* is geared, through the medium of the pinion, direct on to A, the quick fall of the weight will cause A to rotate through a corresponding angle: this the slot *s* allows A to do without affecting A′.

If the float falls, all the motions become reversed, viz.: the rocking piece B becomes thrown over to *g*′, and a negative signal is sent when *b* makes contact with *d*′, for then zinc is to line through *g*′, and copper to earth through *d*″.

It will be evident that the whole arrangement is such that a signal cannot possibly be transmitted unless the weight makes a complete revolution, and then it can only be a momentary signal.

The receiving portion of the apparatus does not possess any particularly novel points. It is represented by fig. 2 (drawn to a smaller scale than the transmitter); M is a horse-shoe permanent magnet, fixed on an axis *a*, so that its poles can move backwards and forwards between the poles of two ordinary electro-magnets *b b*, whose wires are joined together in one circuit. A projecting piece *p*, of the horse-shoe magnet, lies between the bent arms of the levers *l l*. These levers rest normally against the stop screws *s s*. When a positive current passes through the electro-magnets, the permanent horse-shoe magnet is moved, say to the left, thereby moving the left-hand lever, the pawl at the end of which moves the toothed wheel w one tooth forward, representing one inch of movement of the float. Similarly a negative current moves the horse-shoe magnet in the reverse direction, thereby actuating the right-hand lever, and moving the wheel in the reverse direction.

The levers *l l* are so arranged that, when in their normal position, the pawls attached to them stand clear of the teeth of the wheel w. The little wheel w at the end of a spring falls between the teeth of the wheel w and keeps it steady.

THE INDUCTION BALANCE AND SONOMETER.

By PROF. D. E. HUGHES.

(*Continued from page* 183.)

VI. As yet the instrument has given no indications of molecular change produced by magnetism in non-magnetic bodies, but the great change which takes place in all magnetic bodies, except hard-tempered cast steel, indicates that a molecular change of structure, analogous to that of tempering takes place upon iron, steel, and nickel.

If we place a disc of iron in one of the coils, we find that the balance is destroyed, and that the iron has weakened the induction by the absorption of work done in inducing the circular currents. This can be perfectly balanced by placing a small coin or disc of silver or copper in opposite coils; but if an iron wire

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or rod is placed perpendicular to the coils, the increase of inductive force takes place in those coils by the conduction of induced magnetism from primary to secondary, and the iron can no longer be balanced by silver, copper, or any non-magnetic metal. The coils must be either removed farther apart, so as to reduce the increased force, or balanced by an equivalent amount of iron or magnetic conduction in opposite coils.

An interesting case of both reduction and increase of force in the same pair of coils occurs if we place a disc of iron, not in the centre of the coils, but in the vacant space between the coils. We thus reduce the force by 150°. If, in addition to this, we place iron wires perpendicular and in the centre, there is increase of force, and if this increase is so proportioned as to be 150°, we immediately restore the balance, and we have here in the same coil two separate pieces of iron, each disturbing the balance and giving out loud tones, but producing no effect whatever, when both are introduced at the same time, complete silence being the result.

VII. These coils prove what has already been long known, viz., that hard steel has a far less conducting power for magnetism than soft iron, although the hard steel has a far higher retaining power. This instrument demonstrates a point, which I have not yet seen remarked, that magnetism does not in itself change the conducting powers, but that it produces a molecular change of structure in iron, analogous to that of tempering; for if we balance two soft iron rods against each other, the balance being made perfect by the addition of fine iron wires on the weakest side, we find that on strongly magnetising this bar, by drawing it across a strong compound magnet, and on replacing it in its coil it has lost 30 per cent. of its conducting power; or if, instead of magnetising, we make this iron red hot and plunge it in cold water, the loss of conducting power will be very similar—25 to 30°. If these experiments are repeated upon various degrees of iron approaching steel in character, we find that as it already possesses hardness or temper, it is less and less affected by magnetism, until we arrive at hard cast steel, where magnetism no longer produces any change in its conducting powers. From this I draw the conclusion that the effect of magnetism is very similar to that of temper, and shall show under the effects of strain and torsion that magnetism produces this temper or strain perpendicular to the lines of magnetic force.

VIII. The instrument shows that a remarkable change takes place in the magnetic conducting power of iron and steel on subjecting the wire under examination to a longitudinal strain; for if we pass an iron wire through the centre of both coils, half a millimetre diameter and 20 centims. or more in length, so arranged by a winding key that we can apply a strain to this wire, we find a magnetic conducting value, unstrained, of 100, but on applying a slight strain its value rapidly increases, being more than double at its breaking point. If during this strain we strike the wire, we hear its musical tone, and no matter how much we may wind or unwind it, provided we do not pass its limits of elasticity and similar wire is used, that the same musical tone will invariably give the same magnetic value. Thus the note A, or 435 complete vibrations per second, gave always the magnetic value of 160, or 60 per cent. increase of power over the unstrained wire. If whilst this wire is strained, giving the value 160, we magnetise it by drawing over it a strong compound magnet, the note remains the same, showing no difference of tension, but its magnetic value has fallen 80°, being now 80 instead of 160; and this wire can never again be brought by strain up to its previous high conducting powers. Now, as we have seen, that magnetism produces no change in hard-tempered steel, but that it does so in soft iron very analogous to that of temper, and as the effect of strain would be also to harden the fibres by bringing them all parallel to the line of mechanical strain; and as this improves its conducting power, while magnetism instantly destroys all the benefits of the longitudinal mechanical strain, we can only draw the conclusion that magnetism produces a strain analogous to temper, but contrary to that of the longitudinal mechanical strain; in other words, that the magnetic strain is produced perpendicularly to its lines of force.

This view is sustained by the effects of torsion; for if, in place of straining the wire, it is twisted, instead of increasing, it rapidly decreases in magnetic conductive value, each turn or twist decreasing its power of conduction in a remarkable constant line of decrease. At 80 turns of this wire there was a decrease of 65 per cent.; at 85 turns the wire broke, and on testing it to see if magnetism had any decreasing effect on it, I found that it produced no change whatever; but this twisted soft iron wire had now remarkable permanent retaining powers of magnetism, being superior to tempered cast steel.

Again, if we take three similar pieces of soft iron wire, leave the first for comparison in its natural condition, strain the second by a longitudinal strain until it is broken, and twist the third by a torsion-key until it also is broken, we find on magnetising equally these three wires, and allowing ten minutes repose, that the first or untouched wire has a retaining power of magnetism of 100, the second only of 80, the third, or twisted wire, of 300. I hope by the light thus given soon to be able to produce a magnet whose force shall be greatly in excess of what we have hitherto possessed; our difficulty at present being that in order to temper steel, we must heat it to redness, and this allows the molecules to rearrange themselves contrary to the object we have in view.

IX. There is a marked difference of the rapidity of action between all metals, silver having an intense rapidity of action. The induced currents from hard steel or from iron strongly magnetised are much more rapid than those from pure soft iron; the tones are at once recognised, the iron giving out a dull, heavy smothered tone, whilst hard steel has tones exceedingly sharp. If we desire to balance iron, we can only balance it by a solid mass equal to the iron to be balanced. No amount of fine wires of iron can balance this mass, as the time of discharge of these wires is much quicker than that of a larger mass of iron. Hard steel, however, can be easily balanced not only by steel but by fine iron wires, and the degree of the fineness of these wires required to produce a balance gives a very fair estimate of the proportionate time of discharge. The rapidity of discharge has no direct relation with its electrical conductivity, for copper is much slower than zinc, and they are both superior to iron.

X. The instrument shows a marked difference in all metals, if subjected to different temperatures. The value is reduced in non-magnetic metals, and this we should expect from the known influence of temperature on the electrical conductivity; but in the case of iron, steel, nickel (as it has already been remarked by many), the contrary takes place, namely, a far higher degree of magnetic conductivity. A bar of soft iron, whose value at the temperature of the room, 20° C., was 160, became on heating it to 200° C., 300, that is to say, its value was nearly doubled. A bar of pure nickel, whose value at 20° was 150, became on heating it to 200°, 320; thus, in the case of nickel, its value for magnetic conductivity was more than doubled, and

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at this heat it surpassed the chemically pure iron at the same heat, giving a magnetic value of 320 against 300 for the iron, but at the normal temperature of 20° the iron had more magnetic power of conduction than nickel. Heating nickel by simply plunging it into boiling water increased its force from 150 to 250, plunging this same bar into ordinary cold water reduced its value to 130; thus the mere difference of the normal temperature of the air in the room and water which had been in this room some hours produced 20° of difference. In fact, I found that the radiant heat from the hand would raise the magnetic value several degrees, and thus nickel may be regarded as a magnetic thermometer far more sensitive than the ordinary mercurial Centigrade.

The instrument also measures the electrical resistance of wires or fluids. In order to make it do this, we have only to place the resistance to be measured across the two wires of one conduction coil and on the other known resistance units. In this way we can produce a perfect balance, for it then becomes an induction bridge, the results and modes of testing of which are somewhat similar to Wheatstone's bridge.

It measures also the electrostatic capacity of Leyden jars or condensers, and is sufficiently sensitive to appreciate and measure a surface of tinfoil not larger than four inches square, the condenser being simply placed between the wires of one pair of coils, and the disturbance produced being measured on the sonometer.

I could cite many more interesting experiments in other branches of physical research for which this instrument offers a wide field of observation; but my object this evening is neither to broach new theories nor to correlate at present the results obtained with views already advanced by Ampère and others.

My only desire has been and is to show the wide field of research the instrument opens to physical enquirers. I trust that, in more able hands, it may serve to elucidate many physical phenomena.

NOË'S THERMO-ELECTRIC PILE.

By ALFRED NIAUDET.

THIS thermo-electric pile is constructed in various forms of which the figure represents the most simple and the smallest.

The elements are in plan placed horizontally and radiate like the spokes of a wheel; the heated junctions lie towards the centre, and the cold junctions towards the outside, as shown in fig. 1.

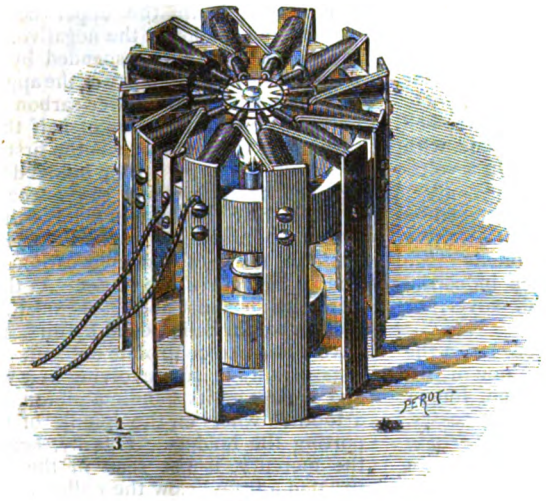

FIG. 1.

FIG. 2.

The two metals are 1st, German silver, and 2nd, an alloy of antimony, which melts at a temperature a little above the fusible point of antimony; but the exact composition of which has not been made public.

These two metals are soldered together (at least at the hot junction) without the intervention of any other metal; the wires of German silver have fixed at their extremities little capsules of brass which serve as moulds into which the other metal is cast. One of these little capsules is visible in fig 2, which represents a single element of the natural size; it remains attached to the element and forms part of the apparatus.

In the same capsule a little lug of copper penetrates, the extremity of which is equally held in the cast metal, and by means of which the heat is conducted to the hot joint.

The opposite extremities of the lugs of copper are joined and arranged in a little circle and heated by a peculiar flame from a lamp burning methylated spirit, or by a Bunsen burner.

In order to concentrate the heat of the flame, the latter is covered by a circular disc of mica, which is held by the copper lugs.

Each cold junction is slightly different: here the fusible metal is soldered to a plate of copper, to which are soldered the German silver wires of the following element.

The plate of copper exposes a large surface, and has for its object the cooling of the junction by radiation in the first place, and by contact with the air in the second.

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These plates of copper can be plunged into water at their lower extremities, so that the cooling of the cold junction can be more effectually done; but practically this expedient is not always adopted.

The cooling by the influence of the air is simpler and is practically found to be sufficiently effectual.

These piles have been tested with great care by M. Waltenhofen of Prague; he has compared them with those of M. Markus, and finds them to be very superior to them.

The results of experiments by M. Stephan, show that the thermo-electric elements of Markus have an electro-motive force of one-eighteenth of a volt; but that this maximum corresponds to a temperature very near the fusing point of the metal of which the elements are composed.

Under similar conditions, M. Waltenhofen has found that the elements of Noë, have an electro-motive force of one-ninth to one-tenth of a volt.

Practically, these maximum values must not be expected, and when several elements are connected together, these maxima are never obtained, because all the elements do not become heated to the same degree, and about one-sixteenth of a volt for electro-motive force, and one-fortieth of a Siemens' unit (*) for resistance represents about the power of the pile.

A very useful addition to the apparatus, consists in the addition of a gas regulator for the prevention of the overheating of the pile. This is liable to happen from an increase on the pressure of the gas supply, an increase in the heat being thereby produced, which may fuse the metal of the elements and thus destroy the pile.

The regulator is particularly useful with the large piles, composed of a great number of elements, but can be dispensed with in the smaller piles of the kind illustrated.

With a small pile of 12 elements, an electric bell can be rung and similar experiments made; with 20 elements, water can be decomposed in a voltameter.

With 40 elements, a Planté secondary pile can be charged, or an induction coil worked; in fact, these answer for all the usual physical experiments made with an ordinary battery, and for small industrial operations, such as plating with gold, silver, or nickel, &c.

A great advantage of these piles consists in the fact that they attain their full power in one or two minutes, and the moment they are no longer wanted, the gas can be put out and all expense ceases.

In fine, and this point is important, *the pile does not deteriorate or change from constant use.* This is not the case with those which hitherto have been made, and which, after a time, considerably increase their resistance, so that the strength of the current they give, becomes at last so weak as to render the pile useless.

SUDRE'S THERMO-PILE.

ONE of the most important of the new French thermo-piles, designed for the electric lighting of large shops, offices, halls, and theatres, is that of M. Jean Marie Sudre, a detailed notice of which we are compelled, from want of space, to defer until our next. It will be remembered that Clammond's pile failed because of the heat source coming in contact with the thermo-electric joints themselves, and gradually consuming them. In Sudre's pile this danger is obviated by interposing a guard material between the heat source and the junctions. The heat source may be steam or hot liquid, heated air or gas circulating in flues past the protected hotter thermo-electric junctions. A large heating surface is offered to the circulating medium. Coke or coal is burned in the pile, which requires no skilled attendance except occasional stoking. Three electric lights, steady and brilliant, can be produced from it, and, as the waste of an intermediate dynamo-electric machine is suppressed, at a cost much less than the cost of gas. Any lamp may be used, but an improved form of Serrin is at present preferred. This thermo-pile is about to be introduced into England by Mr. Applegarth.

(*) Waltenhofen—Dingler's Polytechnisches Journal, 1877. Vol. 22, page 265.

NEW ELECTRIC LAMPS AT THE ALBERT HALL.

(*Continued from page* 184.)

KRUPP'S LAMP.

The novelty in this lamp, which is the invention of Baron von Krupp, the celebrated manufacturer of heavy ordnance, consists in the application of an automatic brake, instead of clockwork, to regulate the length of the arc. The figure gives a side elevation of the lamp, the upper being the positive carbon, and the lower the negative. The holder of the upper carbon is suspended by a jointed chain from a pulley in the centre of the apparatus as shewn, and the holder of the lower carbon is similarly supported by a second pulley of half the diameter, but turning on the same axle as the first pulley. When, therefore, the upper carbon holder descends a certain distance by its weight, the lower holder *ascends* through half that distance. By this arrangement the arc between the carbon points keeps a fixed position, since the positive carbon wastes away at double the rate of the other. As the weight of the upper holder must not be too small, for fear that its motion would be impeded by dirt, it is necessary to have a brake to control its descent. This brake consists of a fly or fan revolving in a well of mercury, and having on its spindle a pinion which gears into a toothed wheel on the spindle of the pulleys supporting the holders. This fly, being immersed in the mercury, is not seen in the figure, but it is situated a little below the pulleys. To prevent the fly from revolving backwards when a new carbon is inserted into the lamp, the tooth-wheel is fitted into a small pawl wheel which locks the pulleys.

When the current is put on it passes first through the hollow helix of wire, which is shown at the base of the figure on the left. This helix is encased in iron to exalt its magnetic effect on an axial core, which is free to move up and down in its interior. A brass rod links this core to the other mechanism of the brake, which consists of a disc turning on the axle of the pulleys, and a brake block fixed at the angle of the jointed lever shown. The current pulling down the core is by this means made to press the brake block against the edge of the disc,

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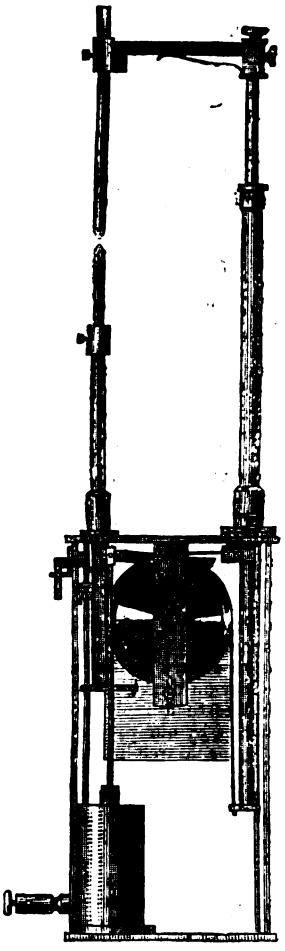
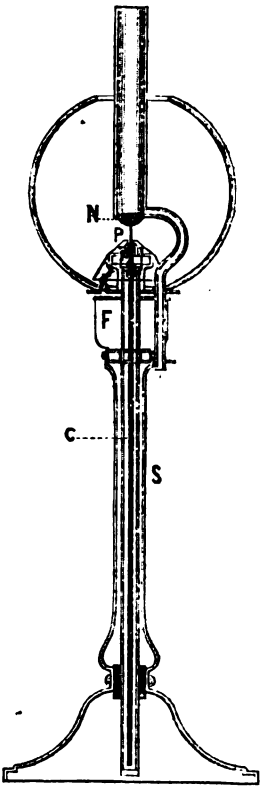
so as to turn it back a few degrees; but as the pulleys are also turned back with the disc, the carbons are thereby separated and the arc established. When the arc widens and the current weakens, the core rises in the helix and slackens the pressure of



the brake block on the disc; the latter, therefore, moves forward, and the carbons approach until the equilibrium is again established. Both the backward and forward ranges of the pulleys are limited by small but ingenious adjustments. This lamp has been introduced by Herr Krupp into his gun factory at Essen.

HIGGINS'S ELECTRIC LAMP.

This lamp is, as will be seen from the illustration, a modification of Werdermann's original lamp. Instead of raising the lower positive carbon rod against the upper negative electrode by means of cords and counterweights, Mr. Higgins has hit upon the plan of floating it up in mercury. The neatness and convenience of the lamp is thereby increased; but the light itself is not, perhaps, in any way improved. In the figure, s is a brass stand for the lamp, enclosing an iron tube c, filled with mercury, and having at its top an enlarged chamber, also partly filled with mercury. P is the carbon stick floated in the mercury, and guided against the upper carbon N by a tubular guide tipped with copper as shown. A ventilator of radial blades of copper F, surrounds the lower carbon, and as the tube c gets warm, a current of air flows up the interior of the stand s, and escapes between the blades of the vent, thus cooling the lamp. Similarly in the upper



carbon holder a current of air passes inside it from below and escapes above. A globe encloses the whole as shown.

Notes.

THE ELECTRIC LIGHT.—Werdermann's lamp has been modified by M. Kreiger, Paris, so as to make it operate in any position. The under carbon is pressed against the upper electrode, which consists of a block of compressed magnesia, by means of a spiral spring under its base. Two or more of these carbons may be placed side by side, as in Wilde's candle, and the arc established between their points, against the underside of the magnesia.

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THE *Neptune* turret ship, known as the *Independencia*, when in the possession of the Brazilian Government, and now at Portsmouth, is ordered to be fitted with Wilde's electric light.

THE Shah of Persia is stated to have introduced the electric light into his palace at Teheran.

WERDERMANN'S ELECTRIC LAMP.—The engineers of the City of Paris are about to test this lamp for street illuminations. MM. Herz and Noaillon have replaced the upper carbon disc in it by one of copper, so that only one carbon electrode, the positive, is required, a plan first conceived, we believe, by Dr. Siemens. At a recent soirée, in the house of M. Liepmann, Werdermann's lamp was kept alight from 9 p.m: to 2 a.m. by the current from eighteen Bunsen cells.

THE TELEPHONE.—We hear that the impending suit of the Bell Telephone Company *versus* Messrs. M. Jackson & Co., has been removed from the Master of the Rolls Court to the Court of Vice-Chancellor Bacon, and that the Telephone Company have given a bond for £200 as security for the defendants' costs in the action. It is expected that the case will be tried on June 20.

THE AUDIOMETER.—It appears from the audiometric researches of Dr. Richardson that contrary to all expectation, the ears of women are much inferior to those of men both in acuteness and range of hearing. This apparent anomaly is thought by some philosophers to arise from the feminine habit of never listening to reason. Be this as it may, however, the deficiency in question is, unfortunately, more than compensated for by the greater perfection of the female articulating organ. Would that our ears were blunter!

A MICROPHONIC PLOT.—In the interests of the musical profession, and especially of the first and second violinists, as well as of the big drumist, perhaps, we think it right to reveal the following attempt to involve us in a dastardly plot. This letter comes to us from America :—Dear Sir,—Pardon me for writing to you, i write to ask You if you would be Kind enough to tell me how a Microphone is made, or else i will give you the reason why i want to know, and you can experiment on it, i think that i can make a Guitar sound Louder, by taking ideas from the microphone, and i thought that if you might not want to experiment on it, you might tell me how a microphone is made so that i could experiment, i am a poor Young Married man, Struggling hard to get along, and i play the Guitar, and i thought if i could make the Guitar sound louder, it would be one of the main Instruments in a band, it would do away with second and third violins, and would give better satisfaction, and now I ask you either to make that improvement yourself so that I can procure a loud sounding Guitar and introduce it in a Band, and make a living by it, or else you tell me how a microphone is made, so that i can experiment on it, and you will receive your reward. Please answer, i will enclose postage stamp for an answer.

THE *Faraday* is about to embark the first part of the Pouyer-Quartier Atlantic cables at Messrs. Siemens' works, Charlton, and is expected to sail with it before the end of June. It will be laid between Brest and the Scilly Isles.

THE time occupied in transmission of the result of the late Derby by the Direct United States cable from the London office of the Company to the destination of the message in New York, was 59 seconds.

THE Chilian fleet has destroyed the submarine cable off Arica. Telegraphic communication with Autofagasta is also interrupted.

BY the conditions of our treaty with Afghanistan, a line of telegraph will be erected between Cabul and India, *via* the Khurum Valley.

THE British Association meeting for this year will be inaugurated at Sheffield, on Wednesday, August 20th, by Prof. G. J. Allman, President. On the 22nd Mr. Crookes will discourse on "Radiant Matter"; and on the 23rd Prof. W. E. Ayrton will lecture to working men on "Electricity as a Motive Power." We also hear that Mr. Chandler Roberts, F.R.S., Chemist to the Mint, will give the result of his electric analysis of alloys by means of Prof. Hughes' Induction Balance.

IN *Scribner's Magazine* for June there is begun a series of articles on Edison and his inventions. In *Good Words* for the same month there is an interesting article by Sir William Thomson on Compass Adjustment.

MR. PRESCOTT UNDER CRITICISM.—We were recently under the necessity of criticising somewhat severely the latest literary performance of Mr. George B. Prescott, the new American electrical writer who knows so well how to enrich his pages with the best work of European authors, and who, it seems, has gained no inconsiderable reputation in his own country from the skilful manner in which he has tricked himself out in these borrowed plumes. Mr. Prescott does not appear, however, to be so ready to appropriate foreign criticism. Our remarks, which were directed principally against the barefaced manner in which he attempted to cover up the merit of Professor Bell in the invention of the speaking telephone, and of Professor Hughes in the discovery of the microphone in favour of Mr. Elisha Gray on the one part, and Mr. Edison on the other, called forth a reply from that gentleman, which was answered by our reviewer in the same number. [*See* T. J. for March 15 for the criticism itself, and T. J. for May 1 for the review.] Now, it turns out that Mr. Prescott felt rather proud of his reply, for he has caused it to be published *in extenso* in the American *Journal of the Telegraph* for May 16; but with that fine sense of impartiality, which is so conspicuous a feature in all his works, he has omitted both the criticism itself and the critic's answer. For the credit of American journalism, it is to be hoped that this shining instance of fair play is confined to the official organ which Mr. Prescott sways; and we sincerely trust that the spirit of that very famous author will not spread to other institutions of the United States, for example, the Law Courts, for then we should expect to see all the evidence for the plaintiff suppressed and only that of the defence communicated to the ears of the jury. But, indeed, Mr. Prescott is welcome to any triumph he may gain upon such terms.

ELECTRICAL RESEARCH.—Formerly in the days of the supremacy of classical education it was thought that books and lectures could impart all that was necessary for a student to learn; then people began to realise that practical work was equally important, and laboratories grew into existence. But even in the present day the repetition of standard experiments in these laboratories is thought to be the proper work for the learning mind; could not, however, that large amount of care and time that is bestowed, where laboratory training is in favour, on the repetition of some such measurements as those of Regnault, be better employed in advancing existing knowledge; for, although it may

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not fall to the lot of every one to discover a telephone or phonograph, it is quite within their power to aid, even if it be in a very small degree, in extending our acquaintance with the laws of nature. Consequently we regard it as a step in the right direction that Dr. Muirhead and Professor Ayrton, at their laboratory, adjoining the Telegraph Works of Messrs. Latimer Clark and Muirhead, intend making one of the most important parts of the education of their pupils the training them to carry out original research in electricity and magnetism. Of course, in addition, the students of telegraphy will be taught the manufacture and testing of electrical apparatus, and the mathematical and experimental theory of electricity as applied to telegraphy. We may expect that the experience which Dr. Muirhead has gained in successfully solving the difficult problem of duplexing with his patent "Inductive Resistances" so many of the long cables in the Indian and Atlantic Oceans and in the Mediterranean and Red Sea, combined with the experimental skill that has enabled Professors Ayrton and Perry to carry out so many electrical and other investigations in Japan, will be of great assistance in the training of Telegraph Engineers who desire, not only to practice satisfactorily their profession, but who in addition aim at advancing it by invention.

MUNIFICENT GIFT.—At a recent meeting of the Iron and Steel Institute, the following letter from Dr. C. W. Siemens was read by the President, Mr. C. Williams:—"It having been recognised by the members of this, as well as other institutions, that it would be desirable to have a building of sufficient capacity to represent the societies cultivating the various branches of applied science, as suggested in my inaugural address to the Iron and Steel Institute in 1877, I move that the committee then appointed to promote that object, and to confer with other societies, be re-appointed, and with a view of giving effect to their efforts I hereby offer to give the sum of £10,000 in aid (loud cheers) of the construction of such a building on a suitable site at Westminster, the work to be carried into effect under the supervision of a joint committee; to be presided over by the president of the Institution of Civil Engineers, or his representative" (renewed cheers). The President proceeded to read a resolution of the council, gratefully accepting Dr. Siemens's munificent offer, and appointing a committee to confer with the Institution of Civil Engineers, Institution of Mechanical Engineers the Institute of Naval Architects, the Society of Telegraph Engineers, and such other bodies as might be suitably included in the project.

MR. DAVID BROOKS' system of underground telegraphs has been purchased by the Western Union Telegraph Company for 230,000 dollars. The patent consists in insulating telegraph wires in cotton, and laying the whole in a wrought iron pipe filled with petroleum. This is done to protect the wires from the moisture of the ground. Experiments have been made with this system by the Pennsylvania Railway Company using it in its block signallings with marked success. The wires, encased in pipes, were laid in trenches beside the track. The purchase by the Western Union is for the patent right for the United States only. Already arrangements have been made for the introduction of the system in New York city. Two thousand conductors are to be laid between now and September next, embracing all of the city east of Broadway. This is the initiatory step toward doing away with the overhead system altogether. When General Stager bought the right to use the system in this country it was particularly stated that he was acting in his individual capacity and not for the Western Union Company, of which he is an officer. Yet no one doubted, nor do they doubt now, that there was a thorough understanding between General Stager and the Western Union. This is proved by the prompt arrangements which have been made to introduce the system in New York, which will do away with the Western Union's overhead wires.

PLOUGHING BY ELECTRICITY.—M. Tresca has succeeded in ploughing a field by electricity near Sermaize, in France. Three Gramme machines were employed; the first making 1,200 turns a minute, was driven by a steam engine of six horse-power. This current drove a second machine 400 metres off, at a speed of 1,120 turns per minute, or a third machine 980 metres distant, with a speed of 980 turns per minute, according as it was shunted. The two last machines, which were portable, propelled two ploughs, which were of the Brabant type, by means of two cables. The available power in the process was estimated at three horse-power, showing a loss of 50 %.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

To the Editor of THE TELEGRAPHIC JOURNAL.

ADER'S TELEPHONE.

SOME difficulties having been experienced by English experimenters in making Ader's telephone from the description we recently gave of it, we applied to Count du Moncel, who has favoured us with the following remarks:—

"SIR,—The figures which you have published in the TELEGRAPHIC JOURNAL are sufficiently explanatory to render unnecessary any further description of the telephone of M. Ader. The figure in the number of the Journal for April 1st, 1879, is of full size, and exactly like the model which I have tried; the wire of the little bobbin is of No. 32 gauge, ·0000185 millimetres in thickness. The instrument is very simple and works always very well when the transmitter is good and is used with a Leclanché battery of the new form. The best transmitter to employ is that of Edison, but the one represented by fig. 7 may also be employed with success. Your correspondent has also tried the apparatus constructed by M. de Combettes, of 92, Rue de Bondy. M. Carpentin, successor to M. Ruhmkorff, has succeeded in obtaining with this system speech through the frame of a door. It was sufficient in order to do this, to fix in the door-frame an iron wire attached at each end to masses of metal and surrounded by a bobbin of fine wire. On applying the ear to any part of the frame, speech can be heard very clearly.

"The system of M. Ader has been patented and the patent has been bought by the Edison Telephone Company of the Avenue de l'Opera; but this company has not as yet occupied the premises, and it is M. de Combettes who has up to the present constructed the pattern of which you have given a cut in your number for April 1st, 1879. I do not know if by reason of the patent it can provide receivers, but certainly it can transmitters, and this is of the most importance, for with ordinary microphones the results are not always satisfactory. There is, however, still the transmitter of M. Bondet of Paris, with which the apparatus works perfectly.

"Being at this moment unwell, I am unable to give you as full details as I would otherwise have done.

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"I pray you to accept the assurance of my most distinguished sentiments,

"M. DU MONCEL."

[Our readers will regret to hear that the eye affliction produced by a too zealous study of electric lights, from which Count du Moncel suffers, is still an impediment to his labours.—ED. T. J.]

THEODOR SCHNEIDER.—We are sorry to say that we have been unable to find out whether any book containing a list of German words suitable for telegraphic code purposes, or a German Code book has yet been published? but we fancy that none has been. Perhaps some one of our subscribers may be able to give the information.

C. H.—Thanks for promised paper. Congratulations.

Reviews.

The Student's Text-Book of Electricity. By HENRY M. NOAD, Ph. D. F.R.S. F.C.S. A new edition, carefully revised, with an introduction and additional chapters by W. H. PREECE, M.I.C.E. London: Crosby, Lockwood & Co. Price 12s. 6d.

DR. NOAD'S Text-Book has earned for itself the reputation of a truly scientific manual for the student of electricity, and we gladly hail this new and amended edition which brings it once more to the front. Mr. Preece, as reviser, with the assistance of Mr. H. R. Kempe and Mr. J. P. Edwards, has added all the practical results of recent invention and research to the admirable theoretical expositions of the author, so that the book is about as complete and advanced as it is possible for any book to be within the limits of a text-book. The illustrations are the sorriest features in it; but this is due rather to the engraver or the printer than to the authors.

L'eclairage Electrique. By the Count du MONCEL, Member of the Institute of France. Hachette and Co., Paris and London. Price 2fr. 50c.

COUNT DU MONCEL has followed up his little work on the telephone, microphone, and phonograph, a translation of which has, we observe, been published by C. Kegan, Paul, & Co., London, by another upon the Electric Light. It is, like the former, a contribution to the *Bibliotheque des Merveilles*, and is, therefore, intended for the general public; but it is so fully and well illustrated, that the professional electrician may profit by it. M. du Moncel possesses, in an eminent degree, the French talent for elucidating a theme, and in the present work renders his brilliant but occult subject perfectly clear to all.

Electric Lighting and its Practical Application; with results from existing examples. By J. N. SHOOLBRED, B.A., M.I.C.E. London: Hardwicke and Bogue. Price 5s.

To electricians wishing in a short time to make themselves acquainted with the history and present development of electric lighting, we would recommend this little treatise of Mr. Shoolbred. It is a professional book rather than a popular one; but anyone knowing the rudiments of electricity can clearly follow it throughout. The chapters on Motive Power and Luminous Intensity are especially valuable and novel; the various photometers employed being fully explained and illustrated in the latter.

The Electric Light in its Practical Application. By PAGET HIGGS, LL.D., D.Sc. London: E. & F. N. Spon. Price 9s.

DR. HIGGS is well qualified to produce a book on the subject of the Electric Light, and since his translation of Fontaine's work is out of print, we gladly hail this original treatise of his which embodies much of the latter and adds to it the best of the later forms of electric lamps and machines. The first chapter deals with the voltaic arc and incandescence; the various lamps and machines are then described, followed by a full consideration of the mechanical efficiency of these machines, with sufficient mathematical data to enable the reader to judge of the merits of the machines. The question of cost is next discussed, and the applications of the light, both odd and common are clearly described. Final chapters are devoted to current regulators, and to the manufacture of carbons. Dr. Higgs has been at considerable pains to do his work well, and has carried the history of electric lights further back than any other writer except Colonel Bolton. For example, he illustrates Straite and Edwards two-carbon lamp (p. 9). He, however, unfortunately omits De Moleyn's incandescent lamp, and gives King's as the first. The Messrs. Spon have made a handsome volume of the book.

New Patents—1879.

1622. "Means employed for producing the electric light." R. C. THOMPSON. Dated April 24.

1635. "Electric light apparatus." J. MACKENZIE. Dated April 25.

1652. "Improvements in and relating to printing telegraph apparatus." W. R. LAKE (communicated by C. Hayet). Dated April 26.

1688. "Portable magnetic appliances in conjunction with medicinal substances for the cure of diseases." T. WELTON. Dated April 28.

1692. "An improved mode of regulating electric currents." J. S. LELLON and H. EDMUNDS. Dated April 30.

1766. "Improved method of demagnetising iron ships." H. HOPKINS. Dated May 5.

1791. "Electric lamps." J. S. LELLON and H. EDMUNDS. Dated May 6.

1949. "Improved apparatus for generating electric currents." J. S. LELLON, H. EDMUNDS. Dated May 15.

2000. "Electric lamps." J. COUGNET. Dated May 20.

2011. "Improvements in electro-magnetic puncturing or stencil pens, and printing apparatus or stencilled plates or paper (complete)." J. M. JOSIAS. Dated May 20.

2019. "Improvements in the apparatus employed in traction, and in other apparatus employed in mines, agriculture, and navigation, by the application to these apparatus of the required motive power transmitted by means of an electric current." J. CHRETIEN and C. FELIX. Dated May 21.

2060. "Apparatus for electric lighting." A. F. BLANDY. Dated May 23.

2110. "Improved means and apparatus for producing light and heat by electricity. C. W. SIEMENS. Dated May 27.

2111. "Electric lighting apparatus." W. R. LAKE (communicated by J. Puvilland and T. Raphael). Dated May 27.

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2199. "Lighting by electricity." J. FURSTENHAGEN (communicated by L. Siemens). Dated June 3.

2211. "Telephones." H. C. DOUMONTIER. Dated June 4.

ABSTRACTS OF PUBLISHED SPECIFICATIONS—1878.

3603. "Flexible electric conductors and tips therefor." G. J. STANFORD. Dated September 12. 6d. This consists in forming flexible conducting cords which will not strain the wires.

3647. "Transmitters for telephones." H. HUNNINGS. Dated September 16. 6d. This describes an Edison carbon transmitter, formed of two metal plates containing a layer of powdered carbon between.

3656. "Manufacture of electrodes for electric lighting." A. H. P. STUART-WORTLEY. Dated September 17. 4d. This consists in covering carbon electrodes with a hood of asbestos (silicate of magnesia) or other refracting substance; and of mixing asbestos or other heat-resisting materials with the carbon, to form the electrodes. The electric arc is caused to take up a position in front of the carbon points by means of a deflecting magnet.

Proceedings of Societies.

PHYSICAL SOCIETY.—MAY 10TH, 1879.

Prof. W. G. ADAMS in the Chair.

New Member—Mr. J. KESTRELL EVANS.

DR. WOLLASTON explained the construction of Gower's improved form of Bell's speaking telephone. *See* TELEGRAPHIC JOURNAL for March 1st, 1879.

Prof. W. F. BARRETT then gave an account of some attempts which he had made to overcome the induction clamour on telephones, caused by the ordinary telegraph currents on neighbouring wires. He had tried recently the Bell telephone on a line from Dublin to Armagh, 95 miles long, but the induction noises completely stifled the speaking, whereas the Edison transmitter gave good results. The clamour could be got rid of either by neutralising the induction currents, or by eliminating the noises from the speech. He had taken the second line of experiment. Since the vocal currents differ from the induction ones in potential and period, he attempted to make the latter discharge across from the line to earth by fine needle points, and from a heated spiral of wire in a vacuum, leaving the vocal currents to pass on to the receiver, but without success. Also, since the vocal currents are alternately positive and negative, whereas the induction ones are of one sign, he tried to avail himself of the difference in discharging power of positive and negative currents, but without success. He then tried to take advantage of the difference of period or duration of the currents, the induction currents being longer. He therefore tried to break up the induction currents by interposing a rapidly revolving current interrupter, and to make the sections of the musical note obtained *interfere* with each other by means of an acoustic interference tube, but practically failed in this also. He mentioned these facts for the benefit of others who might be going over the same ground.

Mr. WILSON then read a paper on the Divisibility of Electric Light by Incandescence. By Joule's law, the amount of heat developed in a circuit of resistance R by the passage of a current $C = C^2 R$. Where R is the resistance of generator and connectors r, added to the resistance of the light emitter or incandescent wire P.

Therefore since by Ohms law $C = \frac{E}{R}$, we have

$$C^2 = \frac{E^2}{(r+P)^2} \text{ and } C^2 P = \frac{E^2 P}{(r+P)^2}.$$

From this equation the value of P may be also determined. $C^2 P$ is the amount of heat developed in the incandescent wire. We see from it that the smaller the mass of the wire the higher the temperature generated in it, therefore the mass of the wire should be diminished until the fusing point of the metal is almost attained. The question of divisibility resolves itself into our being able to divide a single incandescent source into a number of smaller ones, giving the same total illumination. The author concludes that this can be done by arranging the subdivided sources in "multiple arc" or parallel circuits, provided the total mass, length, and sectional area of the united sources be the same as in the original single source. The objection that increased radiation from the various sources would diminish the first total of light and heat can be met by making the smaller wires still smaller than is theoretically required so as to generate more heat. The author regards the "voltaic arc" as probably falling under the same law: the mass however being smaller in this case.

Dr. COFFIN then exhibited a Trouvé Polyscope, which consists of a small hand incandescent platinum wire electric light, designed for illuminating the more inaccessible cavities of the body in surgical examinations. The current is supplied by a Planté secondary battery, and the light is half enclosed in a small silver reflector, fitted with a convenient handle. The apparatus is portable. Dr. Coffin found that it was open to several objections which he has remedied. Firstly, the heat generated made the lamp so hot that it could not be held to the body for more than a very short time. He overcame this by making the reflector of double silver plates, and circulating water between by means of india-rubber pipes and a bulb, which can be worked by the patient himself, thus serving to distract his attention from the operation. Secondly, the secondary battery exhausts itself in twenty minutes, and the light therefore goes out, while from 12 to 24 hours are required to recharge it. Dr. Coffin has superseded it by a Leclanché battery of eight elements, made by Messrs. Coxetter & Sons, in which the carbon pole is replaced by a copper plate faced with platinum, and no porous diaphragm is employed. This gives a constant light for hours.

SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of the Society of Telegraph Engineers, held on May 14, MAJOR BATEMAN-CHAMPAIN in the chair, a paper was read by LIEUT.-COL. FRANK BOLTON, Hon. Sec. of the Society.

Colonel BOLTON, after expressing his debt to Professor W. E. Ayrton for the great assistance rendered by him in the preparation of the paper, stated that his object had been to do a service to electrical inventors by giving them an intelligent summary of the ideas and plans already patented in England on the subject of Electric Lighting. The paper was divided very skilfully into a great many heads, treating of different types of machines and lamps. There are so many of these that we cannot do more than give a few of the most remarkable results brought to light by Col. Bolton's researches into the forgotten archieves of the Patent Office. The paper itself, will, however, appear soon as a pamphlet.

The earliest mention of the accumulation principle in magneto-electric machines seems to have been made in Jauff's patent in 1854. In 1857, Dr. Werner Siemens described the dynamo-electric principle to a German Scientific Society.

In 1866, Messrs. Cornelius and S. A. Varley, patented a plan for producing alternating magneto-electric currents by a vibrating tuning fork, as recently

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patented by Edison. The currents of Varley were, however, to be used for telegraphic purposes.

The first patent of the Wilde type of machine having a disc of bobbins parallel to the axis of rotation was due to King in 1846. The Lontin type having revolving bobbins radial to the axis, was first indicated by Allan's 1852 patent.

An incandescent electric lamp was first patented by De Moleyns in 1841, and in 1848, a platino-iridium wire, enclosed in glass, was also protected.

The first patent for "flowing electrodes" of mercury was taken out in 1853 by Binks; and the first for flexible electrodes by Scott, in 1878. In 1853, Binks also patented a vibratory electrode caused to approach and recede from a fixed electrode as in the plan recently devised by Professors Houston and Thomson. Disc electrodes were first patented in 1845 by Wright; multiple electrodes in 1846, by Greener; non-conductors associated with the carbons in 1849, by Pearce; and carbon candles in 1864, by Werdermann, to produce flame for melting rock in boring, as in Jamin's candle, described in our issue for April 15. Lamps regulated by clockwork were first patented by Staite in 1846; those having a fixed length of arc, as in the Wallace-Farmer, by Roberts in 1852; those regulating in one direction (as the Dubosq), by Jackson in 1852; those regulating either up or down (as the Foucault), by Staite in 1847.

In 1853 also, Staite floated up one electrode in a fluid; a plan which Mr. Higgins and M. Ducretet have also devised. In the same year Binks patented a process for impregnating carbons with metals and other bodies to produce a white light.

PHYSICAL SOCIETY.—MAY 24th.

Prof. W. G. ADAMS in the Chair.

New members: Mr. SEDLEY TAYLOR, M.A., and Mr. WALTER EMMOTT, A.S.T.E.

Mr. W. J. WILSON exhibited a new harmonograph and figures drawn by it. The figures drawn by prior harmonographs are all more or less imperfect, owing to loss of motion in the pendulums actuating the marking pen; and Mr. Wilson therefore designed a new harmonograph, which not only gives perfect figures but admits of the phase of either of the two compounded motions being decreased by a known amount. In this instrument toothed wheels take the place of pendulums, the ratio of the teeth giving the ratio of the periods of the motions. By employing the device of an intermediate wheel gearing with two others and arranging two or more wheels on the intermediate axle, a great variety of phase can be obtained for each motion. An ingenious adjustment by means of a movable nut allows the phase of either or both motions to be altered to a known extent, and then an endless variety of figures can be obtained. As in other harmonographs, a writing table on which the paper is placed and an aniline glass pen are used. Several of the figures, done also on glass, were thrown on the screen, the stereoscopic effect being very apparent. In reply to a query Mr. Wilson said that he had adapted some of the figures to the stereoscope.

Prof. HUGHES explained his new induction balance, and showed some of its principal effects. It is well known that on starting an electric current along a wire adjacent to another wire an induced current is set up in the second wire in an opposite direction to the first or primary current. In the induction balance two primary circuits or coils are taken, with the same current (interrupted by a microphone acted upon by the ticking of a clock) running through both, and between these is placed a secondary circuit or coil in connection with a telephone. The primary coils are so wound as to oppose each other's induction on the intermediate secondary. There is a point, moreover, between them where these opposed inductive influences exactly neutralise each other. If the secondary coil be placed there no induced ticking of the clock can be heard; but if the secondary be displaced to one or other side of this point the ticking can be heard in the telephone, increasing in loudness as the secondary approaches one or other of the primaries. If the distance between the primaries be graduated into a scale this contrivance becomes a sonometer, since it gives an absolute zero of sound with degrees of loudness. It is well adapted for measuring the hearing power of the ear.

By splitting the secondary coil into two parts, and placing each close to its proper primary, so that there are four coils in all, arranged in two pairs, the extremes in one primary circuit, and the means in one secondary, the two opposing parts of the balance can be separated from each other, so as not to disturb each other's action, and the balance made very sensitive by the closeness of the primaries and secondaries. Professor Hughes finds that there is a line or zone of maximum induction midway between each primary and its secondary. If a conductor, such as a piece of metal be put in this position, it has a maximum disturbing effect on the balance, due probably to the electric currents generated in it by the induction. The effect is apparently proportional to the conductivity of the metal. It requires an exactly similar piece of metal put between the other pair of coils to restore the equilibrium of the balance. A difference of alloy or of weight between two like coins is at once observed from the imperfect restitution of the balance; base coins are thus also at once detected. Again, it is possible for a person to tell what particular coin or coins are in one part of the balance by trial of the same coins in his part. When plates of non-magnetic metals are held vertical in the balance their disturbing effect is nil; iron on the other hand gives its maximum effect in this position, because its magnetic effect overbalances its electrical effect. Two pieces of iron may therefore neutralise each other as cores in an induction coil. Hard steel is easy to balance compared with soft iron. Zinc disturbs most when placed along the sides of each pair of coils, iron when in centre. A certain length of metal laid along the outsides of the coils produces silence. The maximum line of inductive force is midway between the coils, and there is a line of minimum force at half the thickness of each coil. A metal placed at these lines of minimum force has no disturbing effect on the balance. Pressure applied to small shot, or spongy gold alters the balance.

Prof. W. G. ADAMS believed that one result of Prof. Hughes' experiments will be the determination of the way in which the law of electro-dynamic induction depends on density. He also imagined that the metal when in the maximum line between the coils gathered the lines of force to itself, whereas when on the minimum lines it could not thus divert them.

Prof. AYRTON cited the early experiment of Faraday with a sheet of copper oscillating, to rest between two opposite magnetic poles. The copper took a long time to stop; but a sheet of iron placed between two like poles was soon stopped, owing to its becoming imbued with an opposite polarity, and deflecting the lines of force. He also suggested that the divergence of the results for conductivity of metals got by the induction balance from those got by the Wheatstone balance, might be due to that electric inertia suspected by Sir William Thomson.

Professor GUTHRIE thought that the induction balance pointed to the conclusion that the disturbing effect of a conducting mass applied in this way is proportional

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to the quantity of electricity generated in it under certain conditions of temperature, &c. The determination of the conductivity of liquids would be a useful application of the balance. Henceforth the ear would be used in research as well as the eye.

Mr. CHANDLER ROBERTS gave some results which he had obtained from an examination of certain alloys by means of the induction balance. He had been able to detect a difference in alloy between two shillings of one part in 1,000, and since the law allows a difference of four parts in 1,000, it is probable that considerable saving to the Mint may result from its use. Mathiessen divided alloys into three classes: 1, Solidified solutions of one metal in another; 2, Solidified solution of one metal in allotropic modification of another metal; 3, Solidified solutions of allotropic modification of both metals. For the first class the curve of electric conductivity is a straight line; for the second, a parabolic curve; for the third, a bent line. Mr. Roberts found that the balance gave the characteristic curve for the first class with an alloy of lead and tin, and for the second with an alloy of gold and silver. With a copper-tin alloy, which is a good example of the third class, he found the curve given by the balance to be intermediate between Alfred Risch's curve of density and Mathiessen's curve of conductivity, and judges that the balance is influenced by density as well as conductivity of the metal interposed.

Professor HUGHES said that as the working of metals appeared to affect their conductivity, he was inclined to rely more on the conductivity measurement of the balance than on those of the Wheatstone bridge. In the balance plain pieces of metal were taken, whereas in the bridge wires were mostly taken. He would rather not give any theory yet as to the results obtained from the balance.

General Science.

ENGINES FOR WORKING ELECTRIC LIGHT MACHINES.

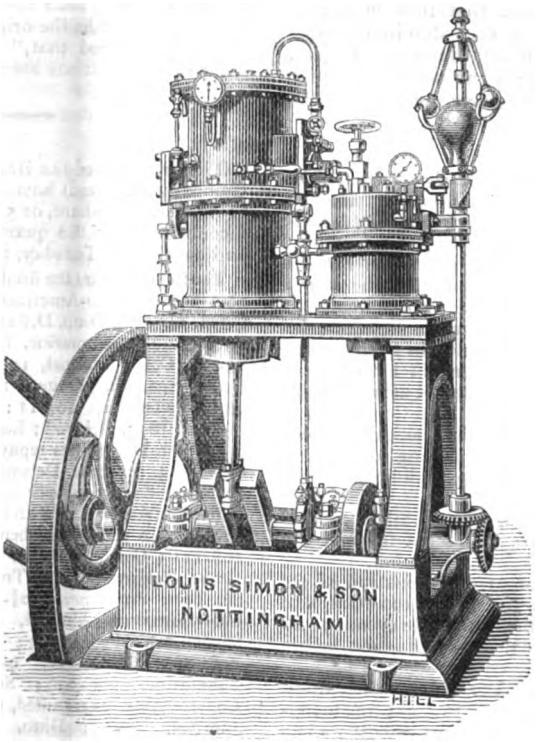
VI.

Simon and Son's Gas Engine.

THIS engine has two cylinders, one for driving and the other, of smaller dimensions, for drawing in the combustible mixture of gas and air, and for transmitting it into the driving cylinder. This gaseous mixture passes into the cylinder through a network of metal gauze, and is ignited on the driving cylinder side of it; the result of this arrangement is that the expansive union of the gaseous mixture, which drives the piston, takes place gradually, as the mixture is forced through the gauze, and on the principle of the safety lamp, the combustion cannot be communicated to the opposite side of the gauze, which would have the effect of causing the combustion before it is required.

The valves and governor, which regulate the admission of the gas and the exit of the products of the combustion, are very simple and effective.

Although the expansive effect of the combustion of the gas and air is a motive power employed in working the engine, it is not the only motive power, and in this point the engine differs materially from others. Each cylinder is water-jacketed, and between the cylinders and the jackets water flows continuously, the source being derived from a bucket or other small receptacle, whence it is pumped by the engine itself. These water-cavities



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are in communication with each other. Now the expansion and combustion of the gaseous mixture necessarily generates heat, and this is communicated to the water surrounding the cylinders, moreover, the spent gases are also very hot, and these being caused to pass through a vessel containing a network of tubes through which the water circulates adds additional heat to the water, so much so that the latter very soon begins to boil and generate steam; this steam is allowed to pass into the driving cylinder, and adds greatly to the motive power. When spent it passes out with the spent gases, adding what heat remains in it to the incoming steam, so that a uniform supply of the latter is maintained. The advantages of this type of engine are numerous. First, no water-vessel to cut the cylinder is required; indeed, the hotter the cylinder the better the engine works. However, the greater part of the heat is utilised in generating steam. Next the utilisation of the steam overcomes another difficulty. The dryness of mere gas explosions is destructive to cylinders, and soon destroys the lubrication which has constantly to be renewed. In Simon's engine no such difficulty occurs, as the steam preserves the lubricating agent intact. Also the pressure of the expanded gas does not exceed 40 lbs., which puts but very little racking strain on the machinery.

There can be no doubt but that this engine, of which we give a general view, is a step in advance. We learn that by a recent improvement, Messrs. Simon have obtained a gain of 20 per cent. in the power of their engine without any increase in the consumption of the gas used.

THE NEW PATENTS BILL.—As clearly formulated by Mr. W. P. Thompson, of the well-known firm of solicitors of patents, High Holborn, the chief provisions of this bill are:—

1st. The duration of provisional protection is to be extended from six months to one year, and the stamp duties thereon lowered to half their present amount.

2nd. A complete specification must, however, be filed before the expiration of nine months from date of original application, or the protection will terminate at the end of the twelve months, and cannot afterwards be renewed.

3rd. The complete specification shall be immediately published, with all other documents relating to the case, and for a prescribed period anyone shall be at liberty to oppose the grant of a patent.

4th. If there be no opposition, the applicant may give notice to proceed, and secure his patent for half the stamp duties now levied.

5th. A patent shall last for 21 years, instead of 14, but shall become void if the £50 and £100 stamps be not duly paid at the end of the third and seventh years respectively, and an additional stamp of £100 before the end of the twelfth year.

6th. Patents can be amended or added to hereafter, but with such fees and limitations as to make an amendment (especially if an addition) almost as costly as an original patent. The amendment, however, then becoming part of the original patent, is not subject to additional stamp duties. (This, however, is still a great improvement over existing practice, and all alterations mentioned so far are in favour of the patentee.)

7th. The Crown shall have power to use any patented invention, paying the inventor such royalty as the Treasury shall consider fair.

8th. If an inventor do not work his invention in the country within three years of grant, and if he refuses to grant licences on such terms as the Lord Chancellor shall consider reasonable, the patent will be annulled.

9th. Inventions, first patented (or imported from) abroad, can in future be patented in England by the foreign patentee (he being the true and first inventor) within six months of the date of the foreign patent, *or of the date of this Act;* but such patents will fall with the expiration of any foreign patent for the same invention, whether granted before or after date of such patent.

10th. The Lord Chancellor shall have power in certain cases to allow a patentee who has accidentally omitted to pay his tax in time, to pay it within three months after it became due, and thereby save his patent.

11th. All patents applied for before the passing of the Act, to be independent of all its provisions, except article 10.

12th. The modes of procedure are altered in many respects, interesting only to patent agents and lawyers.

This bill is decidedly a step in the right direction, though it has faults that will probably be rectified in committee; and it is earnestly to be hoped that it will not share the fate of its less promising predecessors, introduced by the present Government in previous sessions.

ERRATA.—In the letter of M. Gaston Planté on page 187 of our last number, col. 1, line 11, and col. 2, line 5, for the "sun" read the "earth." In col. 1, line 13, for "Whatever be the origin of this polar electricity it must be admitted that," read, "With respect to this polar electricity it has been admitted that."

The directors of the Brazilian Submarine Telegraph Company (Limited) have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, free of income tax, for the quarter ended 31st March, 1879, and payable on Tuesday, the 24th inst.

The following are the final quotations of telegraphs for the 12th inst.:—Anglo-American, Limited, 55¼-55½; Ditto, Preferred, 84½-85½; Ditto, Deferred, 27-27½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 8¼-8¾; Cuba, Limited, 10 per cent. Preference, 16-17½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10½-11; Direct United States Cable, Limited, 1877, 10⅛-10⅜; Eastern, Limited, 7⅜-7½; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11¾-12; Eastern Extension, Australasian and China Limited, 7⅜-7½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10⅞-11⅛; Great Northern, 8½-8¾; Indo-European, Limited, 20-21; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited 9-10; Submarine, 220-230; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1½-1¾; Ditto, 6 per cent. First Preference 7⅛-8⅛; Ditto, ditto, Second Preference, 7½-7¾; Western and Brazilian, Limited, 3⅜-3⅞; Ditto, 6 per cent. Debentures "A," 95-99, Ditto, ditto, ditto, "B," 88-93; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 112-116; Ditto, 6 per cent. Sterling Bonds, 103-105; Telegraph Construction and Maintenance, Limited, 31-31½; Ditto, 6 per cent. Bonds, 108-111; Ditto, Second Bonus Trust Certificates, 2⅜-2½; India Rubber Co., 12¼-12¾; Ditto, 6 per cent. Debenture, 105-108.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 154.

ELECTRIC LIGHTING.

THE general report of the Select Committee of the House of Commons, appointed under the presidency of Dr. Lyon Playfair to consider whether it is desirable to authorise municipal corporations or other local authorities to adopt any scheme for lighting by electricity, and to consider how far, under what conditions, or if at all, gas or other public companies should be authorised to supply light by means of electricity, have now issued the following report, which, if it contains nothing new to any one who has studied the subject, has at any rate formulated in plain terms the present state of electric lighting, and decided that in the event of that mode of illumination fulfilling its present promise it will be wise to keep it out of the tentacles of the gas companies or any other large business monopolies. It will be remarked that the Committee do not urge any definite parliamentary action until the means of lighting have been still further improved, for in a system which is developing with remarkable rapidity, it would be lamentable if there were any legislative restrictions calculated to interfere with that development. They, however, recommend that local authorities should have full powers to test and aid in the development of the light. Summer is now here, and the sun himself has "scattered the rear of darkness thin," so that for the time being there is a cessation in the demand for electric lighting apparatus; but on the return of winter we may confidently expect a renewal of the activity in this direction which marked the same period last year. Mr. Edison obviously made a mistake in sending his famous cablegram on the 4th of October; but it was unfortunate only for his own sake and that of several timid holders of gas shares. His own inventive "thunder" indeed seems to have vanished in the flash of that fatal message; but it has had the effect of firing hidden mines of ingenuity in others which have given a great impetus to electric lighting. The report runs as follows :—

The general nature of the electric light has been well explained in the evidence of Professor Tyndall, Sir William Thomson, Dr. Siemens, Dr. Hopkinson and others. It is an evolution of scientific discovery which has been in active progress during the whole of this century. Essentially the electric light is produced by the transformation of energy either through chemical or mechanical means. The energy may be derived from a natural force, as for instance, a waterfall, or through combustion of a material, in the cells of a voltaic battery, or of fuel in a furnace. The energy being converted into an electric current, may be used to manifest electric light by passing between carbon points, or by rendering incandescent solid bodies such as iridium. A remarkable feature of the electric light is, that it produces a transformation of energy in a singularly complete manner. Thus the energy of one-horse-power may be converted into gaslight, and yields a luminosity equal to 12-candle power. But the same amount of energy transformed into electric light produces 1,600-candle power. It is not therefore surprising that while many practical witnesses see serious difficulties in the speedy adaptation of the electric light to useful purposes of illumination, the scientific witnesses see in this economy of force the means of great industrial development, and believe that in the future it is destined to take a leading part in public and private illumination. There is one point on which all witnesses concurred, that its use would produce little of that vitiated air which is largely formed by the products of combustion of ordinary illuminants.

Scientific witnesses also considered that in the future the electric current might be extensively used to transmit power as well as light to considerable distances, so that the power applied to mechanical purposes during the day might be made available for light during the night. The committee only mention these opinions as showing the importance of allowing full development to a practical application of electricity, which is believed by competent witnesses to have future important bearings on industry.

So far as the practical application of the electric light has already gone, there seems to be no reason to doubt that it has established itself for lighthouse illumination, and is fitted to illumine large symmetrical places, such as squares, public halls, railway stations, and workshops. It is used in Paris for lighting shops which require a light by which different colours may be distinguished, and has recently been used in England for the same purpose with satisfactory results. Many trials have been made for street illumination with greater or less success.

Compared with gas, the economy for equal illumination does not yet appear to be conclusively established. Although in some cases the relative economy for equal candle power is on the side of the electric light, yet, in other cases, gas illumination of equal intensity has the advantage. Unquestionably the electric light has not made that progress which would enable it in its present condition to enter into general competition with gas for the ordinary purposes of domestic supply. In large establishments the motors necessary to produce the electric light may be readily provided, but, so far as we have received evidence, no system of central origin and distribution suitable to houses of moderate size has hitherto been established.

In considering how far the Legislature should intervene in the present condition of electric lighting, the committee would observe, generally, that in a system which is developing with remarkable rapidity, it would be lamentable if there were any legislative restrictions calculated to interfere with that development. The committee, however, are not in a position to make recommendations for conditions which may hereafter arise, but at present do not exist, as to the distribution of electric currents for lighting private houses from a central source of power. No legislative powers are required to enable large establishments, such as theatres, halls, or workshops, to generate electricity for their own use.

If corporations and other local authorities have not power under existing statutes to take up streets and lay wires for street lighting and other public uses of the electric light, the committee think that ample power should be given them for this purpose. There seems to

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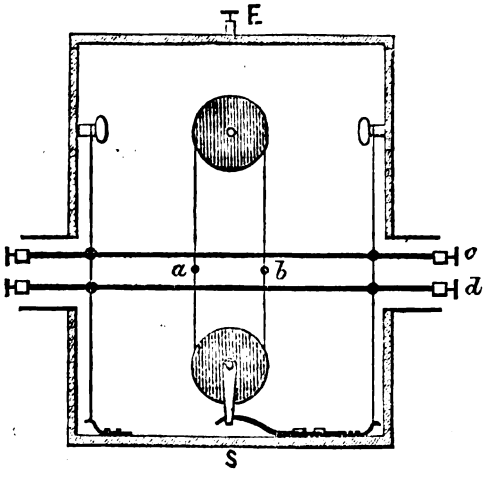
be some conflict of evidence as to whether the existing powers are sufficient or not. But even in regard to local authorities it would be necessary to impose restrictions upon placing the wires too near the telegraph wires used by the Post Office, as the transmitting power of the latter would be injuriously affected by the too close proximity of the powerful electric currents needed for producing light.

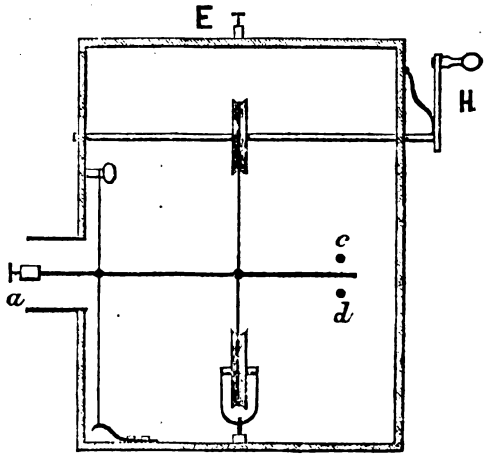
Gas companies, in the opinion of the committee have no special claim to be considered as the future distributors of electric light. They possess no monopoly of lighting public streets or private houses beyond that which is given to them by their power of laying pipes in streets. Electric light committed to their care might have a slow development. Besides, though gas companies are likely to benefit by the supply of gas to gas-engines which are well suited as machines for producing electric light, the general processes of gas manufacture and supply are quite unlike those needed for the production of electricity as a motor or illuminant.

The committee, however, do not consider that the time has yet arrived to give general powers to private electric companies to break up the streets, unless by consent of the local authorities. It is, however, desirable that local authorities should have power to give facilities to companies or private individuals to conduct experiments. When the progress of invention brings a demand for facilities to transmit electricity as a source of power and light from a common centre for manufacturing and domestic purposes, then, no doubt, the public must receive compensating advantages for a monopoly of the use of the streets. As the time for this has not arrived, the committee do not enter into this subject further in detail than to say that in such a case it might be expedient to give to the municipal authority a preference during a limited period to control the distribution and use of the electric light, and failing their acceptance of such a preference, that any monopoly given to a private company should be restricted to the short period required to remunerate them for the undertaking, with a reversionary right in the municipal authority to purchase the plant and machinery on easy terms. But at the present time the committee do not consider that any further specific recommendation is necessary than that the local authorities should have full powers to use the electric light for purposes of public illumination, and that the Legislature should show its willingness, when the demand arises, to give all reasonable powers for the full development of electricity as a source of power and light.

DR. OLIVER J. LODGE'S ELECTROMETER KEY.

THE ordinary ebonite reversing keys used in testing differences of high potentials are open to several objections. For example, they leak considerably, owing to surface moisture, and a coating of sulphuric acid, which corrodes the brass; they have a considerable capacity, owing to the size of their metal parts; and the hand comes too close to them in manipulating them. The new double reversing key, designed by Dr. O. J. Lodge, and exhibited by him at the *conversazione* of Telegraph Engineers, is intended to overcome these drawbacks by giving a high insulation, small capacity, and not requiring the hand to approach close to the effective parts in working it. The nature of the key will be seen from the accompanying figures, which represent one-half of the double key in side and front sections. Four platinum wires are arranged in pairs crossing one another at right angles, one pair, *a*, *b*, crossing midway between the other two, *c*, *d*. These are provided with terminals, and form the contact pieces of the key. They are supported in their places by





vertical silk cords stretched by springs as shown, the middle pair, *a*, *b*, however, being suspended by an endless silk cord which runs on two pulleys, the upper having a handle, H, which appears outside the case, and is worked by the operator's hand. The lower pulley is stretched by a spring, *s*, so as to keep the endless cord taut. The whole is enclosed in a brass case, which is put to earth by

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the terminal E when the key is in use. There are three positions of the handle H, corresponding to three acts on the part of the key; when the handle is in its mid-position, both sets of wires are insulated from each other; when to the right, *a* makes contact with *c*, and *b* with *d*; when to the left, *b* makes contact with *c*, and *a* with *d*. These positions are determined by three small holes in the side of the case, into which a spring stud shown inside the handle falls. With the complete key four different positions can be obtained.

THE INTERNATIONAL DELEGATES IN ENGLAND.

THE delegates of the International Telegraph Conference assembled for their first official sitting, on Tuesday, June 10th, at No. 1, Grosvenor Place, where they were courteously welcomed by the Postmaster-General, Lord John Manners. General Leuders, Director-General of the Russian Telegraph Administration, made an appropriate reply, and the business of the day was forthwith begun under the presidency of Mr. Patey, of the Postal Telegraph Department.

The Conference comprises an imposing array of distinguished men, some of whom are well known to the public at large, and, in respect of attendance at least, the London meeting must be considered the most important which has yet been held. The names of the delegates are as follows:—

Austria: M. W. Devez, Postmaster-General, Dr. Brunner von Wattenwyl, Director of Austrian Telegraphs, Count Victor Wimpffen, Inspector-General of Telegraphs, and a Secretary; *Belgium:* M. J. Vinchent, Director-General of Posts and Telegraphs, and M. Gibbs, Chief Inspector of the Telegraph Service; *Denmark:* Captain H. Höncke; *Germany:* Herr Budde, Director of the General Telegraph Office, Herr Gunther, Upper Privy Councillor of Posts, Herr Scheffler, Privy Councillor of Posts, Herr von Gumbart, Telegraph Director, and Herr Magalle, Secretary of General Telegraph Office; *Great Britain:* C. H. B. Patey, H. C. Fischer, and P. Benton; *Greece:* M. J. Gennadius, Chargé d'Affaires, London; *Hungary:* M. von Koller, Director of Telegraphs; *Italy:* Signor Commendatore, Ernesto d'Amico, Director-General of Telegraphs, and Cav. Berliri, Inspector of Telegraphs; *India:* Col. Champain, Director-General, and Mr. Brasher; *Japan:* M. Yoshikama Akimasa, Head of Telegraph Bureau, and a Chief Secretary of Ministry of Works, and M. Munchiro, Nakano; *Netherlands, The:* Mr. Staring, Director of Telegraphs; *New Zealand:* Sir Julius Vogel; *Norway:* Mr. Nielson, Director-General, and Mr. F. Bugge, Inspector; *Portugal:* V. Do Rego; *Russia:* General C. de Leuders, Director-General, and M. P. Salmonwitch, Chef de Section; *Sweden:* Mr. D. Nordlander, Director-General, and Mr. C. Akerlund, Secretary; *Switzerland:* Mr. Frey, Director-General; *Victoria:* Right Hon. Hugh Childers, M.P.; *Bureau International:* M. Curchod, Director, and M. de St. Martial, Secretary; *Anglo-American Telegraph Company:* H. Weaver; *Brazilian Submarine:* T. Fuller; *Cuba Submarine:* T. Hughes, Q.C.; *Direct Spanish:* C. Gerhardi; *Direct United States:* Captain R. Mayne, R.N., and J. W. Fuller; *Eastern, Eastern Extension, Australasia, and China:* John Pender, M.P., Sir James Anderson, Col. Glover, Lewis Wells, and Jules Despecher; *Black Sea:* Julius Beer; *German Union:* Dr. Lovard; *Great Northern:* H. G. Erichsen, Captain E. Suenson, and Captain W. von Hedemann; *Indo-European:* W. Andrews, Dr. C. W. Siemens, F.R.S., and F. Moll; *Mediterranean Extension:* E. A. Tombs; *Submarine:* Sir J. Carmichael, Bart., Sir J. Goldsmid, Bart., M.P., Arthur Otway, M.P., and S. M. Clare; *West Coast of America:* R. K. Gray; *Western and Brazilian:* Major Wood; *France:* M. J. Richard, Engineer-Director of Telegraphs, M. E. Eschbalcher, Chief Officer of Section at the Postal and Telegraph Department; *British India:* Major H. Mallock; *Servia:* M. Radoykorits, Chief of the Postal and Telegraph Department; *Roumania:* M. Robescu, Director-General of Telegraphs; *British Colonies:* Victoria, The Right Hon. Hugh C. E. Childers, M.P.; South Australia, Sir W. Milne; New Zealand, Sir Julius Vogel, K.C.M.G.

Since their arrival in our midst the foreign delegates have been entertained in a variety of ways; and it is gratifying to find that something has been done to enliven their labours, and inspire them with pleasant memories of "Old England." We are believed to be a cold and proud race by the people of other nations; but perhaps our visitors will henceforth do us the justice to remember that the Englishman abroad is a different being from the Englishman at home, the only place perhaps where he is truly himself.

The Lord Mayor first did the honours of the country to the delegates by inviting them to a banquet at the Mansion House, along with the members of the International Literary Congress on June 12. The following Saturday forenoon they were shown by Dr. C. W. Siemens, over the Telegraph Works at Charlton, where they had an opportunity of witnessing the manufacture and shipping of the new French Atlantic cable, and were afterwards refreshed with luncheon.

On the evening of June 17, a dinner was given in their honour by the joint-reception committee of the Conference at the Freemason's Tavern; Mr. John Pender M.P. occupying the Chair. Many toasts were drunk, and the meeting passed off very happily. Mr. Pender remarked that fifteen years ago there were little more than 2,000 miles of submarine cable in existence, whereas now there were about 66,000 miles, representing a capital of £25,000,000; he advocated the adoption by the Congress of liberal terms to the Press, and hoped that the day was not far distant when all the telegraph lines of the world would be united in a single system. This noble and cosmopolitan sentiment was loudly cheered, a fact which need not surprise us when we remember that it had been preceded by an excellent dinner. Dr. Brunner von Wattenwyl, responding in French, observed that the Congress represented progress by a union of the spirit of conciliation and conservatism, two great principles which had found their brightest illustration in the history of Great Britain. Lord Bury proposed "Our Colonial Empire United by Telegraph."

A visit was also paid by the delegates to the Crystal Palace on June 14, when a most enjoyable afternoon was spent among the galleries and gardens. In the evening the joint reception Committee of the Post Office and Telegraph Companies entertained them at dinner in the Palace, a large number of ladies being present, and Mr. Thomas Hughes, Q.C., the well-known author of "Tom Brown's School Days," in the Chair. In proposing the toast of the evening he said, "Amongst present signs there are few more hopeful than this, of the gathering together, year after year, in friendly conference of those whose work it is to speed and develope the intercourse of nations. It has been our pride hitherto to gird the whole earth with our speaking gear. Already there is scarcely a corner which we have not reached. We have already grounds for the proud motto, '*Qua regio in terris nostri non plena laboris?*' Let us then go on hopefully; in faith that, as intercourse grows and men know more and more of each other, a sounder and better mind will grow also,

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which will inform and inspire that intercourse and make it a sure, and no longer a doubtful blessing to mankind. Let this then be your and our effort, to cultivate in all ways this better and wiser mind—each of us in ourselves, each of us amongst our own people—that these marvellous agencies which are bringing us all more and more closely together, whether we like it or not, may bring us together as friends and brothers, bearing each other's burdens, sharing each other's hopes, rejoicing in each other's progress."

Signor D'Amico made a very graceful reply in French. He said, "My colleagues and myself are very grateful for the welcome, at once so splendid and so cordial, which has been accorded to us in this country; and we are happy to take advantage of any opportunity which presents itself of thanking the Government of England the municipality of the capital, and the telegraph companies for the testimonies of sympathy which they have been so good as to exhibit (cheers), and of expressing our admiration of the General Post Office, of the City of London, and of the various private telegraphic enterprises which are carried on after the manner of the English (hear, hear). I may say to you, ladies and gentlemen, that we deserve to be loved a little by England, since we love her so much (cheers). We have learned from our youth upwards to consider this country as that in which the most intimate alliance exists between order and liberty, between tradition and progress, between moral work and material work, between all classes of society, between the dynasty and the nation (cheers). The spectacle which has unrolled itself before our eyes since we have been here, whilst confirming and strengthening the lessons we have learned, gives us an explanation of the marvellous destiny to which the English people have been called by Divine Providence."

The delegates also paid a visit to Richmond, the "Tusculm" of England's Metropolis, on Saturday, June 21st, where they were entertained at dinner in the "Star and Garter Hotel," by the joint-reception committee of the Post Office and Telegraph Companies. Colonel Holland presided, and M. Vinchent, in response, alluded to England as the birthplace of practical telegraphy, and that happy land where every man could freely express his opinions, whether on telegraphy or anything else.

The other important festivals celebrating the stay of our distinguished guests were the *conversazione* of the Society of Telegraph Engineers, and the visit of the delegates to the India-Rubber and Gutta-Percha Telegraph Company's Works at Silvertown, the first of which events is fully described in another part of the present number. The excursion to the Silvertown Works was a very successful and highly interesting affair. It took place on Thursday, June 19th, the day following the *conversazione*, and was attended by a great number of distinguished men connected with telegraphy. A choice luncheon regaled the party after the various manufactures of the works had been reviewed.

THE CONVERSAZIONE OF TELEGRAPH ENGINEERS.

SELDOM indeed has a scientific *soirée* in London been so successful, brilliant, and agreeable as the *conversazione* of the Society of Telegraph Engineers which took place on the evening of Wednesday, June 18, upon the occasion of the presence of the foreign delegates of the International Telegraph Congress. The western galleries of the South Kensington Museum had been kindly lent by the Committee of Council on Education for the purpose, and all their rich store of scientific treasures, instruments, models, and archæological weapons was exposed to view—a serene and philosophical environment to the purely electrical and telegraphic apparatus which formed the special feature of the exhibition. These galleries were lit by gas, but the open balcony overlooking the gardens of the Horticultural Society was flooded with the artificial day shed from four Siemens' electric lights, hung aloft high overhead like mimic suns. The light streamed down steadily from these dazzling cressets and illuminated the gardens far and wide, enhancing the deep green of the leafy trees, and throwing a kind of romantic glamour over the scene. Part songs, band music, choice refreshments, and, above all, the presence of many distinguished electricians and men of famous note in telegraphy, combined to make the evening as memorable as it was pleasant. The display of electrical apparatus was remarkably fine, and completely wipes away any reproach attaching to British makers for the miserable show which represented their work at the late Paris Exposition.

Taking these objects in the order of the printed catalogue, the spectator was at once arrested by the giant inductorium of Mr. Alfred Apps, the property of Mr. Spottiswoode. The sparks emitted by this powerful induction coil were sometimes 42 inches in length—a veritable lightning flash in miniature. Blocks of glass 1½ inches thick which had been pierced by the discharge were also on view, the clear brittle material having been ground to whiteness along the track of the electric energy. Mr. Latimer Clark exhibited a collection of rare books on magnetism and allied subjects; his oxy-hydrogen mirror galvanometer for indicating delicate electric currents to large audiences; and several interesting antiquities of the craft, such as a portion of the original telegraph line laid by the late Sir Francis Ronalds in 1816, and the original type cast for the Morse instrument.

Messrs. Latimer Clark, Muirhead & Co. exhibited 800 knots of Muirhead's artificial cable, made according to the type of the Malta-Gibraltar section of the Eastern Telegraph Company's system. The construction of this apparatus, by which over 9,000 miles of submarine cable, including the direct United States Atlantic cable, have been duplexed, was fully illustrated by Dr. Muirhead in the TELEGRAPHIC JOURNAL for May 15 and June 1, 1879. A specimen of the interior of one of the boxes, and of the gilt insulated wire for landline duplex, described in these Journals, was also shown. The artificial cable was connected up for duplex working on the Wheatstone balance method, with a Brown and Allan's Relay for receiver at one end, and Sir William Thomson's Siphon Recorder at the other. Messrs. Clark and Muirhead also displayed a variety of apparatus, including Clark's standard elements, small chloride of silver cells, resistance coils, &c. Of these we may specially mention a standard condenser made of mica, coated with shellac, purified with absolute alcohol; Mr. Saunder's new key for signalling on submarine cables by the addition of rubbing contacts to the ordinary pressing contacts; and Mr. Graham's key for use in the Wheatstone Bridge, with the advantage of high insulation from there being no connections under

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the ebonite, and wider spaces than usual between the binding screws.

Mr. Conrad W. Cooke exhibited Sykes' electric lock and block system for railway working, and an ingenious new galvanometer of his own invention for demonstrating the internal current in a voltaic cell. The plates of the cell under test are immersed in the liquid at the upper ends of a curiously blown glass tube, which would have the form of a U tube were it not that the bent portion is drawn out fine and coiled into a spiral, in the middle of which is hung a galvanometer needle. The internal current passing through the liquid in the glass spiral tells its presence by deflecting this needle.

Cowper's Telegraphic Pen; Crossley's Microphone (described in our issue for May 1); Firnhaber's patent synchronous electric clocks, exhibited by Messrs. Edmundson & Co., were also to be seen at work.

Messrs. Elliott Brothers maintained their high reputation as electrical mechanicians by a fine display of galvanometers, keys, and resistance coils; and Mr. Groves exhibited a finished specimen of the Induction Balance of Professor Hughes. An audiometer was also shown by Messrs. Krohne and Lesemann.

The India-Rubber and Gutter-Percha Telegraph Works Company displayed many specimens of their varied manufactures, from submarine cables and dynamo-electric machines, to medical batteries and torpedo fuzes.

The centipede grapnels of Messrs. Johnson and Phillips, which admit of new prongs replacing broken ones, and their patent cutting and holding grapnel for the recovery of cables in deep water, were on view, together with a machine for testing wire by torsion, and a simple but ingenious lead sinker designed by Mr. F. R. Lucas.

The Postal Telegraph authorities made a very extensive exhibit of instruments, old and new, batteries, and testing apparatus. The Bell Telephone Company also set forth a variety of neat ebonite telephones, call bells, and indicators. Messrs. Siemens Brothers exposed a large assortment of electric lamps, including the pattern employed in the Lizard lighthouse, having 22 inch carbons between the holders; and the small Berlin regulator fitted with a 15 inch glass globe, half frosted. Field telegraphs, electric testing instruments, including Dr. Obach's galvanometer, magneto-electric exploders for mining operations, Siemens' lightning guards, and Petri's speed indicator, were also contributed by this well-known firm.

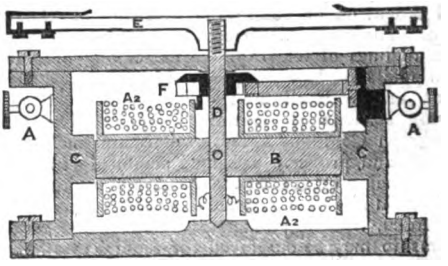
Numerous specimens of submarine cables were exhibited by the Telegraph Construction and Maintenance Company, which illustrated in an interesting manner the comparative anatomy of these terrestrial nerves; and a specimen of the Arica-Iquique section of the Peru Cable (which weighs 5 tons per nautical mile) was exhibited by the West Coast of America Telegraph Company, showing the break caused by the earthquake of May, 1878, in 60 fathoms of water.

There were many other objects of interest which we must perforce omit in this cursory review; for example, the mechanical duplex telegraph and the pneumatic submarine recorder of Mr. Theiler, the marine azimuth compass of Sir William Thomson, and the De Mersanne electric regulator of Mr. Bernard Godfrey. We shall, however, publish full descriptions of some of these novelties from time to time. The electric regulator of M. Hospitallier and the electric mounting table of Mr. F. M. Rogers, are illustrated on another page.

The new patent battery of Mr. W. S. Wilson, of Sunderland, appears to us, however, of sufficient promise to merit a place here. Judging from the specimens exhibited, there is no apparent local action, and the cell is said to be very constant. It consists of three vessels: the inner, which is porous, contains a carbon plate immersed in sulphuric acid and water saturated with nitrate of soda and bichromate of potash; the intermediate, which is of glazed porcelain, supports the zinc plate on its upper edge as a ring, and contains a paste of di-oxide of manganese and sulphuric acid and water, overlaid by moist sand; the outer vessel of stoneware contains simply water. The electro-motive force of this cell is 2 volts, and its internal resistance 1 ohm. We understand that it is being tried just now on the postal telegraphs.

AN ELECTRICAL MOUNTING-TABLE.

THIS little instrument, devised by F. M. Rogers, 29, Moorgate Station Buildings, is intended to supply a want which every user of the microscope must have felt. By the old plan, the table for putting the rings of varnish upon the slide holding the object had to be kept in motion by the left hand, and an uneven constantly varying speed



resulted. Here electricity is the source of power, which is utilised in the following way:—Two wires, from a small bichromate battery, are fixed to the terminals marked A, one of which is connected with the spring and circular contact breaker F. Supposing the spring touches one of the teeth of the wheel, a current traverses the wire A_2 upon the bobbin fixed upon the two arms of the rotating iron bar B. The bar is instantly converted into a powerful magnet, which turns towards the top of one of the inclined planes (of which there are a corresponding number to the teeth in the circular contact breaker), cast in the wall of the iron box. Just before reaching the top the contact is broken, the current ceases, and also any tendency to retard the

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rotatory motion imparted to the table E, fixed by the spindle D, to the bar B. Any desired rate of speed can be obtained by regulating the amount of zinc exposed to chemical action.

THE CAPE CABLE.

THE s.s. *Kangaroo* had arrived at Durban on May 21 with the Natal to Zanzibar section of the Cape Cable. The second section is on its way in the s.s. *Seine*, and the *Calabria* is expected to sail before long with remainder. Difficulties have arisen respecting the subsidy voted by Natal towards the establishment of telegraphic communication with England. When under discussion by the House of Assembly, it was understood to be dependent upon the terminus being within the Natal borders, and the Colonial Secretary has sent a despatch to the Home Government stating that, as this condition was not to be complied with, he did not feel juitified in ratifying the arrangements of the Crown agents. At a meeting of the Chamber of Commerce, which Mr. Forde, the engineer of the colony, attended and addressed, a resolution was passed expressing the hope that the Government would reconsider their decision, and, although the strict letter of the agreement has not been fulfilled, still that was not sufficient reason for withholding the subsidy. It is confidently believed that all the difficulties will be readily overcome. The greatest objection to the terminus is that, owing to the frequent thunder-storms in the summer, the land wire thence is very frequently out of repair. An alternative route, via Pretoria, is now in course of construction.

The agreement between the Government and the contractors requires that the cables shall be capable of transmitting 14 words a minute; and that the company shall, save in case of *force majeure*, have the portion of the cable between Durban and Zanzibar, laid and open for the transmission of messages on or before the 31st day of July, 1879, and the portion between Zanzibar and Aden, on or before the 31st day of December, 1879. The companies are entitled to connect the cable with all lines of telegraph in the colony of Natal at such points as shall be approved by the Natal Government, and with all land and submarine telegraphs having stations or termini at Aden. The Eastern Telegraph Company agrees to maintain and provide a suitable and properly equipped steamship in the Red Sea or Indian Ocean for the purpose of making repairs to the said line of submarine telegraph between Durban and Aden, it being understood and agreed that such steamship may be employed for repairs to other lines owned or worked by that company. All Government messages (whether Imperial or Colonial) are to have priority to all other messages, at rates equal to one-half of those charged to the general public. The stations on the line are to be open from eight a.m., until eight p.m., and throughout the night, when there is any traffic to forward, or when specially required by her Majesty's Government (whether Imperial or Colonial) to be open. It is provided that the rates to be received by the company owning or working the line for messages (other than Government messages) transmitted thereby, exclusive of charges payable to other companies or administrations, shall not exceed the following; that is to say—between Durban and Aden, and vice versa, 5s. a word; between Zanzibar and Aden, and vice versa, 4s. a word; between Aden and London, and vice versa, by any of the lines of the said Eastern Telegraph Company, a total charge of 3s. 9d. a word. And the said rates shall not be increased without the previous consent of the official director, to be appointed. Her Majesty's Treasury may nominate an official director on the boards of the companies owning and working the line, to whom every information and assistance in regard to the said line must at all times be afforded. Her Majesty's Treasury after the date of the effective completion of the line of telegraph between Durban and Zanzibar, and the opening thereof for the transmission of messages, agrees to pay during the term of 20 years an annual subsidy or yearly sum of £17,500, and a like sum on account of the line between Zanzibar and Aden. The payment of these sums is made conditional on the line being kept in good working order. In case of war, rebellion, or other emergency, the Imperial Government of the United Kingdom, or the Government of any British Colony or possession duly authorised by her Majesty's Government in that behalf, may take possession of the cables, stations, offices, and apparatus on the line, and keep possession thereof for so long as they may think requisite, and the companies and their successors in business shall do all in their power to enable the Government to have and enjoy the benefit and advantage thereof. For this privilege the Government agree to make such compensation to the company as shall be admitted or determined (in case of dispute) by arbitration to be reasonable. The last clause provides that the agreement shall not be binding until it has been approved by a vote of the House of Commons.

RESEARCHES WITH PROFESSOR HUGHES' AUDIOMETER.

By BENJAMIN WARD RICHARDSON, M.D., LL.D., F.R.S.*

PROFESSOR HUGHES having done me the honour to show me first his newly invented instrument for the measurement of hearing, and having supplied me with an instrument for the purpose of testing the application of it for physiological and practical purposes, I have been enabled to make a considerable number of experiments, on which I venture to submit the following preliminary report:—

The instrument, as it has been used, is before the Society. It consists of two Leclanché's cells for the battery, a new and simple microphonic key connected with the cells and with two fixed primary coils, and a secondary or induction coil the terminals of which are attached to a telephone. The induction coil moves on a bar between the two fixed coils, and the bar is graduated into 200 parts, by which the readings of sound are taken. The graduated scale is divided into 20 centims., and each of these parts is subdivided into 10, so that the hearing may be tested from the maximum of 200 units to 0°—zero. The fixed coil on the right hand contains 6 metres of wire; the fixed coil on the left hand contains 100 metres. By this means a long scale from the left hand coil is produced. The secondary coil contains 100 metres of wire.

In using the instrument, one Leclanché's cell has been found sufficient, as a general rule, but two have been used in instances where the hearing of the person under test has been very defective. The Leclanché cell was selected by Professor Hughes as affording a reliable current for the purposes he had in view, and for standard comparisons. In using the instrument, the induction coil is moved along the scale from or towards the larger primary, as may be required, and the degrees or units of sound are read from the figures on the scale, the

* Paper read before the Royal Society May 15.

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sound being made by the movement of the microphonic key between the battery and the primary coils.

The person whose hearing is being tested should sit in an easy position, and should not see the act of the observer in moving the microphone key. For good observation, the room in which the experiment is made should be large, and all external causes of sound, such as the ticking of clocks, the vibrations of windows and doors, the moving of feet and the singing from gas jets, should be silenced. The sitter should close the ear that is not applied to the telephone while he is listening for minute sounds, and should give his full and calm attention to the proceeding. Any excitement is like to lead to error when refined measurements are required.

The instrument may be considered to afford the most satisfactory means for testing the hearing power of all persons who can define a sound. The range of sound is sufficient at the maximum—200°—for everyone who is not absolutely deaf; 0°, or zero, is a point of positive silence from the instrument, or rather from the sound which it produces through the telephone.

One of the first facts learned with the audiometer is the suddenness with which the sound is lost to those who are listening. The sound is abruptly lost within a range of 2°; that is within one-hundredth part of the entire scale. This is the case with those who are very deaf as well as with those who hear readily, a fact originally noticed by Mr. Hughes, and which I have corroborated by fifty special observations on different persons presenting powers of hearing which varied from 200° to 140° as the extreme limit or capacity, to complete hearing through the whole scale, down to zero. In these persons, when the observation was taken, under the strictest possible conditions for surrounding silence, the point between distinctness of sound and complete loss of it was not more than one-hundredth part of the scale.

In testing the capacity of hearing, it is noticeable that the power to detect the diminishing sound is maintained best by continuing the reduction in trace or line while the attention is fixed. A sudden break may cause the sound to be lost to the listener long before his real incapacity to hear is reached. If, for instance, the sound be very faintly heard at 15°, and the induction coil be suddenly moved to 5°, the sound at 5° may be quite inaudible; but if the coil be slowly moved, unit by unit, from 15° to 5°, the sound at 5° may be distinctly heard. Mr. Maitland Tate, C.E., who noticed this point very markedly in his own case, when I was submitting him to test, compared this to what is observed by the sense of sight in making surveys. The eye will follow a line to an extreme point with comparative readiness, but if it break away from it, the object seems to have disappeared.

The effect of filling the chest and holding the breath makes a difference in listeners. The capacity for hearing is for a few seconds increased by holding the breath. Mr. Tate, who could hear with his right ear only down to 8° under ordinary breathing, could hear down to 5° when he held his breath. Another gentleman, who could hear only down to 100° under ordinary breathing, could hear to 80° when the breath was held with the chest full. Holding the breath with the chest not full fails to produce the same result.

As a rule, the hearing of persons who are right-handed is most refined in the right ear, and as most persons are right-handed, it is found that the right ear is the best ear. This rule is, however, attended with many exceptions, since, for various reasons, some persons who use the right hand exclusively, practise for some particular purpose the use of the left ear, upon which that ear becomes more acute. Thus five physicians, who were right-handed but who had accustomed themselves to use the stethoscope with the left ear, could hear to zero on that side, but had lost from 4° to 5° on the right side. Four other persons who were similarly circumstanced were able at once to account for the fact by the habit they had acquired of listening to a public discourse or sermon from the left side. Another point of interest attaching to this observation is, that the practice of using one ear for special refinement of the sense seems for the time slightly to impair the other ear, although there is no physical evidence of such impairment.

Connected with last-named fact is another, namely, that by this instrument the deaf are found to fail in capacity of hearing not only by reason of physical defect, but also by failure of memory of sounds. Thus in a youth who had suffered serious defect of hearing for seven years, owing to partial destruction of the tympanum, and who in the right ear could only detect sound at 107°, there was an inability to catch all the sound lying between 130° and 107°, until he could remember what he had to listen for. By practising him then to detect the lowest sound that he was physically capable of receiving, I got him to detect this one sound more readily than those which came higher up. By further practice all the intervening sounds became audible with equal facility. These facts which have been confirmed by another observation on a different person, seem to me to indicate that deafness from imperfection of the tympanum or other parts of the organ of hearing may be increased, beyond the mere physical failure, either from some lost power of automatic adjustment in the auditory apparatus, or from failure of receptive power in the cerebrum itself, so that the memory rendered imperfect is slow to assist the listener until by exercise of function its readiness is restored.

By use of the audiometer, the influence of atmospheric pressure on hearing is detectable. In my own case when the barometer is at 30° I can hear on both sides close down to zero; but below 30° I fail by 2° on the left side to reach zero. In another person a similar failure extends to a loss of 4°.

I have tried to determine in some of the lower animals whether there is the same sense of hearing as in man. In most animals it is difficult to obtain sufficient quietude to enable the observer to gather from expression or movement of the animal the information sought for. In two dogs, one a terrier, the other a field spaniel, I succeeded in making some good observations, and in them the range of hearing power seemed to be distinctly lower than it is in the human subject who has perfect hearing. In both these animals, which were healthy, and in the prime of life, the first indication of the detection of sound commenced at 10° on the scale. The detection was evidenced by the sudden expression of listening, by a slight change of position, and a slight dilatation of the pupils. This detection was clearly made on the instant, as if the sharp line or hearing were the same in them as it is in the higher animal.

PRACTICAL MEMORANDA.

1. The audiometer will, I think, be an essential in all physical examinations of men who are undergoing examination as to their fitness for special services requiring perfect hearing, such as soldiers, sentries, railway officials, and the like.

2. The instrument will be of great use to the physician in determining the value of hearing in those who are deaf, and in determining the relative value of the two organs of hearing. In one instance, already, I have been able by its means to detect in a person who was supposed to be equally deaf on both sides, that on one side the hearing is perfect close up to zero, while on the other side nine-tenths of the hearing is lost.

3. In other forms of diagnosis I have found the in-

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strument useful. In a young person suffering from acute anæmia the hearing was so defective that on the right side it failed to detect sound at 18°, and on the left side at 15°. In ten days, during which, under a new regimen, great improvement took place in strength and general condition, the power of hearing had so much improved that the right ear was good down to 12°, and on the left to 3°; an improvement of 6° on the right and of 12° on the left side.

In another person who was subject to repeated vertigo, the giddiness occurring three or four times a-day, the hearing was so defective that although the external ear on each side was clear and the tympanum natural, no sound could be heard below 30°. Under complete rest and attention to diet, the vertiginous attacks were in a few days removed altogether, and with that removal there was gain of hearing, on both sides equally, up to 5° on the audiometric scale.

4. The instrument may be used to differentiate between deafness through the external ear and deafness from closure of the Eustachian tube,—throat deafness. In my own case I fail to detect sound by the mouth at 170°, and this I find is a fair average in those who are healthy. It represents the comparative value of communication by sound through the Eustachian canal and the external ear.

5. The instrument promises to be very useful in detecting the effects in the body of those agents which quicken or excite the circulation, such as alcohol and other similar chemical substances. I have some observations on these points in reserve for a further report.

6. The instrument promises to be of great service in determining the value of artificial tympanums in instances of deafness due to imperfection or destruction of the natural tympanum. The cotton artificial tympanums introduced originally by the late Dr. Yearsley, and the membranous tympanums introduced by the late Mr. Toynbee, F.R.S., have proved of much service; and by means of the audiometer I have been able very accurately to test their respective merits and to compare both with tympanums made of other material. The enquiry has led me to test different metals for this purpose, and to find in fine gold the substance for making the most useful and effective artificial drum. The Messrs. Ash, of Broad Street, have made for me various forms of gold drums, the best of which, perhaps, is a little cylinder which, with other forms, is placed before the Society. With one of these cylinders I was able to give to a young gentleman who had lost hearing on the right side up to 110°, from destruction of the tympanum, an instant gain down to 60°, a gain of 50° on the audiometric scale.

In this preliminary report I have omitted many subjects of interest, but I hope I have related enough to show that the world of science in general, and the world of medicine in particular, is under a deep debt of gratitude to Professor Hughes for his simple and beautiful instrument, which I have christened the audimeter, or less correctly but more euphoniously, the audiometer.

SUDRÉ'S THERMO-PILE.

IN designing his new form of thermo-pile, M. Sudré has had several objects in view. The characteristic points in the invention are: 1st. Low internal resistance of the couples under a very small volume, and the arrangement of these couples in chains in a particular manner, so as to facilitate their grouping together, and mounting; 2nd. The arrangement of the couples between heating and cooling surfaces; 3rd. The peculiar method of conducting the heat to the one set of metallic junctions; and 4th. The peculiar method of cooling the other set of junctions.

In designing the form of the bars of which the couples are composed, two points have to be considered—1st. The resistance; and 2nd. The tendency of the bar to become equally heated from end to end. Now, as M. Sudré points out, the resistance of a bar varies as $\frac{\text{length}}{\text{sectional arc}}$, and if this proportion be preserved constant, the resistance will remain the same; but the greater the length of the bar, the slower will the heat diffuse itself along the bar. But if the bar be made very long and correspondingly large in sectional area, great bulk will be obtained. The problem then is to determine what dimensions the bars should have to give the best effect consistent with smallness of volume. M. Sudré finds that for differences of temperature of from 10° to 120°, the bars should be 10 to 12 millimetres long, and for temperatures ranging up to 300°, from 20 to 30 millimetres long.

In short couples the method of soldering the points of union of the two diverse metals is a matter of the greatest importance. The junction should be made so that the one metal (in the form of a plate) should be in contact with the whole of the surface of the section of the bar, but at the same time should not penetrate to any depth in the latter, for the effect of its so doing would be to much diminish the electro-motive force of the couple. To obtain this double object, the extremity of the plate forming a couple is cut in the form of a comb (fig. 1), the teeth of which are twisted on themselves, as shown by fig. 2, so that whilst the surface of the twisted metal remains the same, its length becomes much reduced. The twisted cut portions form the connections on to which the bars are cast.

The plate with the twisted prolongations is best, as shown by fig. 2.

Each side of the full part G of the plate is coated with silicate of soda or other heat resisting material.

The mould in which the alloy bars are cast is shown by fig. 3. It is composed of a base C, two side pieces A B, maintained parallel by two cross pieces K and K', and of a cover D, carrying a longitudinal furrow pierced with holes, *d*, equal in number to the number of couples to be contained.

The plates being prepared as described, are placed in the mould between the two side pieces A B; the cover D is then placed on the top and the melted alloy run in, so that the series of plates become bedded in blocks of the alloy, as shown by fig. 4.

The chains of blocks so formed are arranged in the following manner:—

Two metallic plates, A and B, fig. 5, which are represented as planes but which may be cylindrical or curved, are covered on one side with a thin layer of an electrically insulating substance such as enamel. Between these two isolated surfaces is placed one or more of the thermo-electric chains, in such a manner that the extremes of the couples rest upon the enamel surfaces. If several chains are arranged side by side between the two same plates, then they must be arranged so that the opposite poles of two contiguous chains are side by side;

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fig 1.

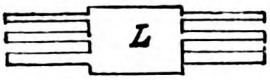
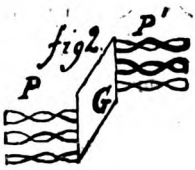


fig 2.



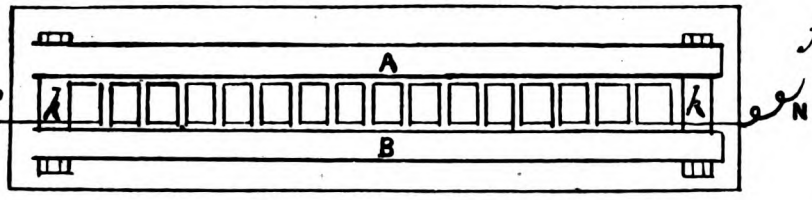


fig 3.

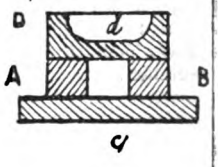


fig 4.

fig 5

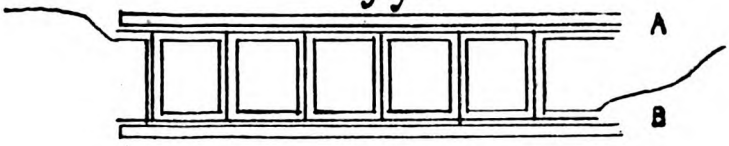


fig 6.

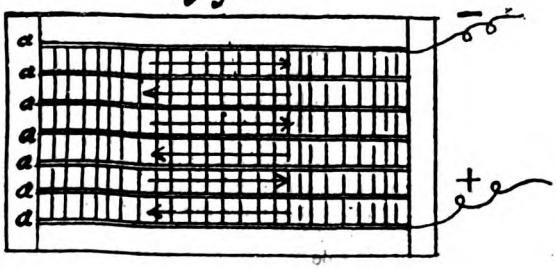
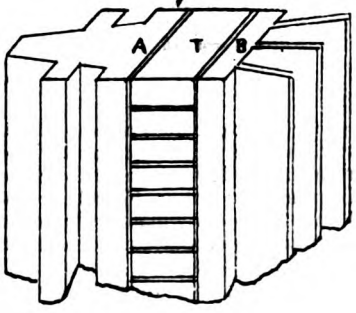


fig 7.



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by this means they can easily be coupled up in "tension." Fig. 6 shows in plan the arrangement of several chains. The contiguous chains are isolated the one from the other by bands *a, a, a, a*, of calorically and electrically insulating materials. All the elements of the chains are electrically insulated from one another by the thickness of the plates, but they are not calorically insulated, so that if plate A is maintained at a high and plate B at a low temperature, the heat will flow across the isolated beds and penetrate the couples, across which it will continue its course from one soldering to another.

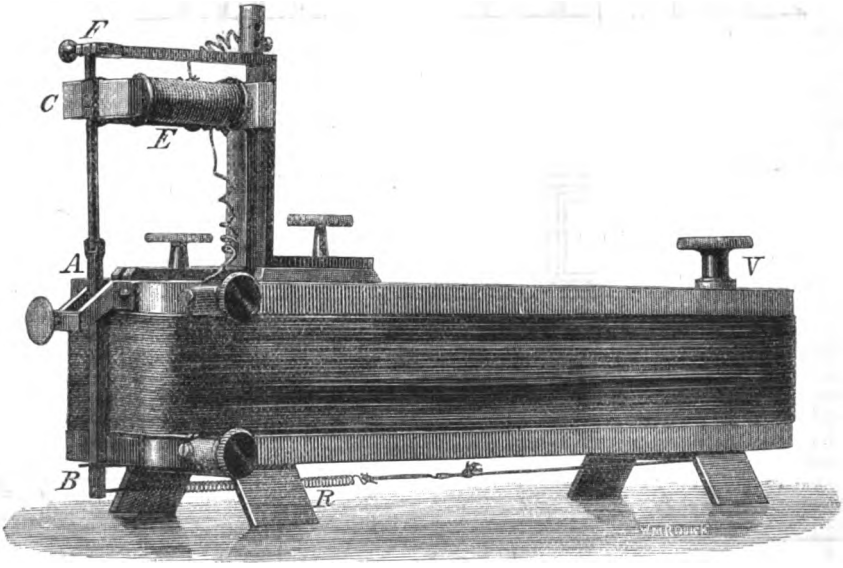
The plates A and B which serve to communicate and withdraw heat to and from the junctions of the couples, form portions of what are called the "collector" and "diffuser," respectively. If the plate A is heated by the direct action of steam it forms the "collector" proper, but when the heating power is heated by gas circulating over the plain metallic surface, then this plain surface is not sufficient to collect the heat and communicate it to the metallic couples. In such cases the surface of the metal is ribbed or has channels formed in it through which the heated gases circulate.

In the case of the "diffuser," the simple plate answers the purpose when the coating medium is simply flowing water, but when, as is usually the case, the heat simply radiates into the air, then the plate in this case is ribbed also. Fig. 7 shows the general arrangement of the "collector" and "diffuser." A is a rib of cast iron forming part of the the collector, and B is a part of the diffuser, the radiating plates in the latter surface exposing a large surface to the air.

In building up the chains with the collectors and diffusers attached to them, the arrangement is usually such that the collectors form the inside of a circle and the diffusers the outside. The heated air then circulates inside the circle so formed as in the Clamond form of pile.

HOSPITALIER'S ELECTRIC CURRENT REGULATOR.

IN a certain number of applications of electricity, such as the incandescence of platinum wires by the electric current, it is a very important point to maintain the current flowing at a certain strength, above or below which it must not vary appreciably.



One of the most effectual means of doing this is to have a resistance in the circuit which can be varied according to the fluctuations in the current strength. M. Hospitalier, a young French engineer, has devised a very simple regulator on this principle.

The apparatus is composed of a resistance bobbin formed of insulated wire wound on in a single layer, and having each turn stripped of its insulating covering for about a centimetre of distance at the same spot. A lever A B, slightly convex, can be made to touch at any particular part of its length the bared portion of the turn of wire immediately beneath that part. This lever, or "divider," has a joint at A, to which is connected a second lever having an armature C, fixed near its other extremity, which armature is placed in front of the electro-magnet E. One end of the wire of the electro-magnet is connected to one end of the wire on the bobbin, the other end is connected to the metal piece on which the end F, of the upper lever, is swung. The other end of the wire of the bobbin is attached to a terminal on the lever part of the bobbin.

A spring R, attached to the end B of the lever, is adjustable by means of the thumb screw V, and by its tension draws the end of the lever, to which it is attached, forward; and the lever, by rocking or rolling on its curved surface, has its upper portion drawn in the reverse direction, that is, it pulls away the armature C, from the electro-magnet. Under these conditions the lower part of the rocking lever

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will be in contact with the bare place on the lowest turn of wire on the bobbin, consequently the major portion of the current conveyed by the wires connected to the two terminals on the bobbin flows from the bare spot on the wire, up the lever, and thence through the electro-magnet back to the second terminal. The armature being consequently attracted, the curved lever is made to rock or roll on the bared surfaces of the wires, thus making contact with turns of the wire higher up the bobbin; but when this is so, the current entering the lower terminal has to traverse all the turns up to the turn with which the lever may be in contact, and the current is thus weakened. Hence it is easy to see that when the spring R, is adjusted to a certain tension, the current flowing will, by pulling the armature C, pull the lower lever on to such a turn of the wire on the bobbin as will introduce an amount of resistance sufficient to produce equilibrium, and if the current weakens or strengthens, the lever will move backwards or forwards until the resistance adjusted by the decreased or increased number of turns in the circuit again produces equilibrium.

To adapt the apparatus for alternating currents, the electro-magnet is replaced by a bar or wire, which expands by the heating effect of the currents.

For dynamo-machines, the apparatus is arranged to be worked by the machine itself. This is done by connecting the rocking lever to a Watts's governor. Under these conditions the apparatus regulates the velocity of the machine, and not the strength of the current.

It is hardly necessary to call attention to the utility of the invention, but the importance may be well understood when we consider that the apparatus bears the same relation to the regulation of the electric currents as the Watts's and other governors, or to the regulation of the flow of steam in steam engines.

PACCINOTTI'S DYNAMO-ELECTRIC MACHINE.

THE novelty in the magneto-electric machine invented by Dr. Antonio Paccinotti of Pisa, in 1860, which we illustrate below, is the peculiar shape of the rotating electro-magnet, which is an iron ring, whose induced poles during rotation move constantly from one point to the other without interruption. About this iron ring coils of isolated copper wire, *a*, fig. 1, were placed, which were connected with each other so as to form a continuous wire. From each connection a conducting wire was brought to metallic pieces *b* of the same number, laid parallel to, and isolated from, each other around the shaft carrying the ring.

FIG. 1.

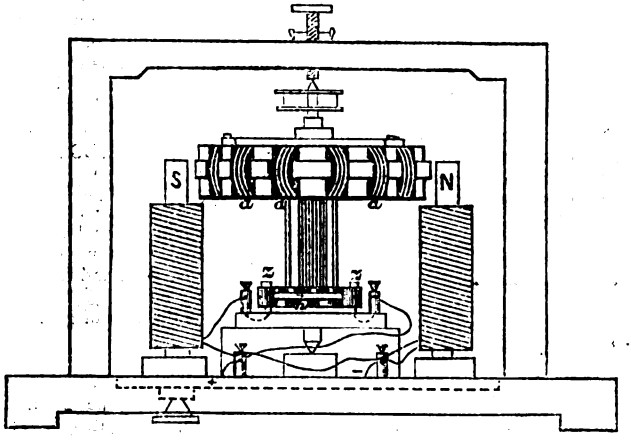
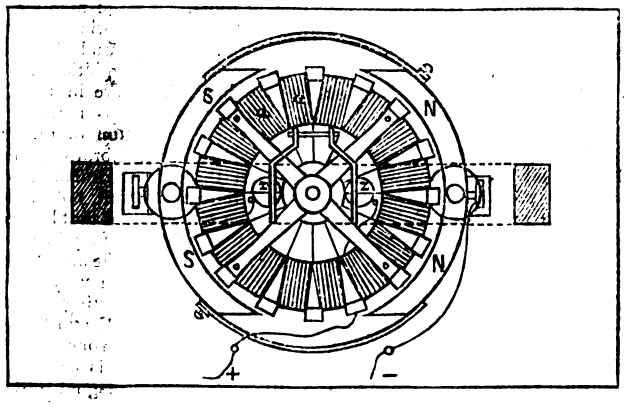


FIG. 2.



The ring was arranged horizontally, and on each side of the diameter was placed one pole of a powerful electro-magnet ending in elongations of soft iron S N, fig. 2, enclosing about one-third of

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the ring on each side. Two rollers *z*, were placed opposite each other, in contact with the above isolated metal pieces, to take off the current when the machine is driven by mechanical power, or to let the current coming from a source of electricity into the ring, when action of the machine is reversed, and motion derived from it by means of electricity. Both actions are provided for by Paccinotti in the description of his apparatus.

It will be seen that this machine involves the principles on which are built the recent generators of electricity. Full importance, however, was only given to Paccinotti's invention after Dr. W. Siemens and Wheatstone, in the year 1867, discovered the dynamo-electric principle, which enabled a machine itself to produce the highest magnetism in its electro-magnets from very feeble residual magnetism in its cores to begin with.

The machine invented independently by M. Gramme, at Paris, in 1870, contained several improvements in construction, and it was left to him to bring this mode of generating electricity into the extensive use obtaining now, though the chief part of his machine is the ring of Paccinotti, with the same principle of action as the Gramme ring.

Gramme used a ring covered with coils in the same manner as Paccinotti, and his process of inducing the currents is the same. He employs, however, in most cases, the dynamo-electric principle; and the whole arrangement of his machine is well calculated for practical use.

Another machine, that of Schuckert, at Nürenberg, shows still more favourable improvements of Paccinotti's ring by the advantageous arrangement of the induction wire, or conductor on the revolving ring, and the reduction of heating in the armature, secured by making the ring flat. (*See* TELEGRAPHIC JOURNAL for April 1.)

Notes.

THE ELECTRIC LIGHT.—Jablochkoff candles are to be set up at several public parts of St. Petersburg.

IT is proposed to illuminate the Falls of Niagara by night with a number of Brush electric lights. The spectacle is expected to be very weird, and embellished with artificial rainbows. An attempt will also be made to light up the falling cascade from behind.

THE Paris "Salon" is lit every evening by electricity from 8 to 11 p.m., and is a great boon to the working classes, who are thus able to see the pictures after labour hours. The colours are not changed, but they seem to have undergone certain relative changes. Green, for instance, is deepened, and gray stands out in bolder relief. The Jablochkoff candles are suspended from the ceiling, and have behind each globe a powerful metal reflector, which throws the light on the pictures. The sculpture is not so well displayed as the paintings, owing to inequality in the diffusion of the light. The success of the experiment ought to encourage our own Royal Academy authorities to adopt the plan for their exhibition in Burlington House.

SIEMENS' electric light is to be tried in the Reading Room of the British Museum for a period of three months. A new Siemens' lamp, which is said to give excellent results, will be employed.

COLONEL HAYWOOD, C.E., the Engineer to the City Commission of Sewers, in a report just issued to them, observed that it might be desirable to set before the Commission what was the amount of light on the Holborn Viaduct, calculated from the Board's data. The light given by the ordinary batswing burner, consuming five cubic feet of gas per hour, was equal to that of about 14 sperm candles. The electric light on the Victoria Embankment, which was similar to that on the Viaduct, was found to be, with the naked light, equal to 378·1 sperm candles, and when enclosed in opal globes, 154·9 sperm candles, the loss by the use of the opal globes being about 59 per cent. of the whole light. There were 16 electric lights in opal globes on the Viaduct, and they displaced, when burning, 86 five-feet batswing burners. The relative lights were from 86 gas burners, 1,204 candles; 16 electric lights naked, 6,049·6 candles, or 16 electric lights in opal globes, 2,478·4 candles. Thus the electric light on the Viaduct, when naked, gave about five times that of the ordinary gas light, and, as enclosed in opal globes, about twice as much. The cost of the electric lighting on the Embankment was less, proportionately, than that on the Viaduct, the arrangements made by the Metropolitan Board of Works being different from those of the Commissioners; the latter body threw the whole responsibility of the electric lighting on the Company, who provided the steam engine, the Gramme machines, and everything needed, except the shed in which the apparatus was placed. The Board obtained its own engine, and conducted the experiment in its own way. Each electric light on the Embankment cost 5·73 pence per hour. Applying that price to the electric lighting on the Viaduct, and assuming the lamps to be kept alight 4,300 hours annually (the same as the gas lamps), the cost per annum would be for the 16 electric lamps, £1,642 12s., (or, without the time of lighting and extinguishing, £1,572 17s. 8d.), and for the 86 gas lamps for a corresponding period, £419, the electric light being nearly four times the cost of gas.

AN exhibition of various systems of electric lighting took place on June 20th, at the works of Messrs. Emmerson, Murgatroyd, & Co., Heaton Foundry, Stockport. A large number of different machines on the "Gramme" principle are being constructed at Heaton Foundry, and the electricity required for the purposes of the exhibition was produced by the Gramme machine. A feature in the exhibition was six of the Werdermann lamps recently introduced, and suitable for the illumination of public halls, picture galleries, drawing-rooms, libraries, and the like. The light given through the medium of these lamps is steady, and, though brilliant, not unpleasantly powerful; and it will be remembered that lamps of the same make have of late been successfully introduced at South Kensington for the lighting of the art library. A single Werdermann light, supplied by a very small Gramme machine, the whole apparatus costing about £40, gave considerable satisfaction. Two Serrin lamps, of about 1,200 candles each, were shown on one ordinary "A" Gramme machine. The division in this case is effected by means of a Blandy's patent magnet governor coil, and marks a great step in advance. A capital method of utilising the electric light by reflection was also shown. A lamp was swung below the roof of the building, and the light thrown upon the ceiling, falling thence below into the workshop. The light so obtained was particularly soft

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and much resembled daylight, whilst every part of the building was well illuminated. The great power of penetration of the light, rendering it valuable for naval, military, and mercantile marine purposes, was shown by means of a parabolic reflector placed on a lamp. It is stated that small print can be read in the rays of this light at a distance of a mile and a half from the lamp.

THE volunteers of Northampton are about to lead the way to a further use for the electric light. Arrangements have been concluded with the British Electric Light Company to light the camp of the 3rd Northamptonshire Rifle Volunteers during a week's camping at Northampton. For this purpose the Gramme machines will be used in conjunction with powerful electric lamps.

WE hear that Werdermann's lamp is to be taken up by the British Electric Light Company.

DR. HOPKINSON in his evidence before the Parliamentary Committee on Electric Lighting, stated that his experiments showed about 50 per cent. of the electricity obtained from the mechanical energy of the machine was lost in heating the wires and parts of the machine. Mr. Shoolbred, the well-known draper, Tottenham Court Road, stated that he now used 20 electric candles instead of 230 gas jets, the cost of the candles being 37s. 3d. per night in winter, and 9s. 10d. in summer.

TEMPERATURE OF THE ARC.—M. Rosetti, Professor at the University of Padua, has found the temperature of the voltaic arc produced by eighty Bunsen elements to be 3,500° C., that of the positive pole 2,870° C., and that of the negative pole 2,400° C. With fewer cells the temperature was lower. His results were obtained by measuring the amount of radiation.

THE TELEPHONE.—A very exhaustive little treatise on the telephone, by Mr. Conrad Cooke, will shortly be issued by the proprietors of *Engineering*.

THE MICROPHONE IN MINES.—The use of the microphone as a detector of the signals made by imprisoned miners by blows on the coal rock has been suggested. Were the Morse or other code put into the hands of miners these signals might be rendered intelligible.

A PACIFIC CABLE.—That eventually a cable will be laid from the Pacific Coast to the Sandwich Islands, Japan and China, there can be no doubt. When this line is established the telegraphic circuit of the world will be complete. Mr. Cyrus W. Field holds an exclusive concession from the government of the Sandwich Islands for such a cable, as was announced at the recent celebration of the twenty-fifth anniversary of the organization of the company which resulted in laying the Atlantic cable. Concessions will also be obtained from Japan, and probably from China. We understand that the organization of a company to carry out this project is proposed, and that Mr. Field has agreed to contribute 100,000 dollars in cash as a subscription to its capital stock. It is expected that capitalists upon the Pacific coast, who will naturally feel a pride in the establishment of such a line, will also contribute liberally to give the project a start and carry it through. The business interests of the coast would be greatly facilitated by such a connection. Mr. Field sailed for Liverpool on the 21st ult. in the Cunard steamship *Bothnia*, and during his sojourn in England will make such investigations in regard to the manufacture and laying of a Pacific cable as will enable him and his associates to act understandingly in furthering the proposed enterprise. No steps will be taken towards organizing a company until after the return of Mr. Field. It is to be hoped that sufficient encouragement will be extended to insure the construction of the line at no distant period.—*The Journal of the Telegraph*, U.S.

AN Indian paper states that bamboo telegraph poles are being shipped from Madras to Natal.

COWPER'S TELEGRAPHIC PEN has worked between Waterloo and Woking, on the South Western Railway. This distance is 26 miles, but resistance was added to the circuit to make it equivalent to 100 miles. It worked well, and the only disturbance from induction currents on neighbouring wires was an occasional tremor of the pen.

THE July number of Mr. Edmund Yates' new magazine, *Time*, contains a paper by Mr. Scudamore and an article descriptive of the Central Telegraph Station.

TROUVÉ'S POLYSCOPE has been re-invented by a young Saxon doctor, named Nitze, and termed an endoscope. It consists of a platinum wire kept red hot by an electric current, and enclosed in a glass bulb, and is designed to illumine the cavities of the body. Messrs. Coxeter and Sons also exhibited a similar apparatus at the *conversazione* of Telegraph Engineers.

THE new German-Norwegian Cable is expected to be laid in August.

ASSAYING BY INDUCTION.—In our article on this subject, in our last number, we stated that variations in the composition of alloys not exceeding the one ten-thousandth part could be indicated by Professor Hughes' induction balance, "a degree of accuracy which far exceeds any known method of analysis." Mr. Chandler Roberts points out to us that this statement is not quite correct. He is satisfied that, under certain conditions, the induction balance will show smaller variations than those we indicated; but, on the other hand, even in the ordinary method of assaying gold, the probable error is included within a range of two ten-thousandths, that is, an error of plus or minus one ten-thousandth.

AMONG the enemies of underground telegraph lines in England, Mr. W. H. Preece describes a species of fungus and an insect called the *Tempeltonia Crystallina*.

IT is proposed to have a special electrical section in the Scientific Exhibition to be held in Paris from July to November next.

MAGNETIC IRONSTONE.—Herr Narr finds that the specific magnetism of magnetic ironstone is greater than that of any other magnetic substance known. Its permanent magnetism exceeds that of glass-hard steel, and is sooner neutralised by external forces than that of steel.

INDUCTION SPARK IN VACUO.—M. Du Moncel has pointed out that the dark space seen surrounding the negative pole in a Crooke's vacuum can also be observed by the microscope; also in the case of an induction spark in air.

WE have received from M. Gazau de Vantibault, President of the Trans-Sahara Commission, a pamphlet advocating in eloquent language, the construction

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of a railway and telegraph line from Algeria to the Soudan.

THE AMERICAN RAPID TELEGRAPH COMPANY, says the *Engineering and Mining Times*, U. S., is the title of a new organisation just formed, which is affirmed by newspaper report to be the owner of valuable improvements that will enable it to materially cheapen existing telegraphic rates. One of the novel inventions it is reported to control, but of which no published description has yet appeared, is a system of transmitting 1,000 words per minute. The following are among the reforms which the public are promised when the new organisation is once at work: (1.) Immediate despatches (express messages) will be transmitted to all stations east of the Rocky Mountains at the uniform rate of 25 cents for 30 words. (2.) Mail messages will be dispatched within an hour, and delivered through the nearest post-office, or by messenger within two hours from time of reception, at 25 cents per 50 words. (3.) Press reports, for exclusive use of one paper, at 10 cents per 100 words. (4.) Night messages, to be delivered before 9 a.m., at 15 cents per 50 words. (5.) Stamped messages, a novel suggestion, by which, with the co-operation of the Postal Department, a postal telegraphic system, using special stamps, will facilitate rapid transmission of business by telegraph. The company, it is affirmed, promise within three years to telegraph ordinary business letters to and from all points of the country for 10 cents. The company, it is further affirmed, will at once set about constructing a double line of wires to connect the principal cities of the Union east of the Rocky Mountains, using the highways and post-roads, which the law of 1866 leaves them free to use.

The "Electro-mechanical Telegraph," the "Real Duplex Telegraph," the "Multiplex Telegraph," the "Metrical Telegraph," the "Line and Page-printing Telegraph," the "Electric-generating Machine," and the "Speaking Telephone," are the somewhat revolutionary implements of the new adventurers.

Proceedings of Societies.

PHYSICAL SOCIETY.—JUNE 14TH, 1879.

Prof. W. G. ADAMS in the Chair.

New Members—DONALD MACALISTER, B.A., and Mr. ST. GEORGE LANE FOX.

PROF. MACLEOD described a plan for suppressing the induction disturbances in a telephone circuit. It is known that a secondary battery composed of metal plates and sulphuric acid allows weak currents to pass while stopping those of high tension. Prof. Macleod had inserted a secondary battery of platinum plate between the line and the telephone, but this stopped both the induction and the vocal currents. When platinum wires were substituted for the plates, however, the induction currents were stopped, while the vocal currents could be feebly heard.

Dr. O. J. LODGE exhibited his new reversing key for electrometer work, which is illustrated on another page.

Mr. J. F. MOULTON then demonstrated the results of the experiments of Mr. Spottiswoode and himself on the sensitiveness of electric discharges in vacuum tubes. These experiments were undertaken to find the cause of the luminous layers or strata in the discharge, a Holtz machine being employed. It was observed that when feeble currents were drawn from the machine, the discharge could be depressed by laying the finger on the tube, and this depression always occurs with intermittent currents, therefore the feeble currents form a continuous current. Holtz discharge themselves, like intermittent currents, by reason of their feebleness. This sensitiveness of the discharge to the approach of the finger was found to be due to the conductivity and electric capacity of the hand. Electricity opposite in kind to the discharge is induced on the finger, and streaming upon the tube, neutralises part of the discharge therein. This effect was also shown by means of tinfoil rings round the tube. An intermittent current is of course capable of this static induction on neighbouring conductors. The luminous discharge in a vacuum tube consists of a bright sharp glow at the negative terminal, followed by a dark space, then a hazy bluish light at the positive pole. The striæ or layers in these sensitive tubes merely repeat this appearance. They can be artificially produced by placing the fingers, or rings of metal at intervals along a tube conveying an amorphous discharge; for in this case the induced electricity discharging itself from the fingers, breaks up the amorphous discharge into dark and bright layers. In these stratified discharges the electricity appears to travel *per saltum*, or by stepping-stones, as one may say, and the glow seems to be a molecular structure, a view which is supported by Mr. Crookes's experiments. A negative discharge from the finger produces a dark space in the tube discharge, and a positive one a bright line; therefore one can tell the kind of discharge passing in a tube by laying a finger on it. If the same pole be brought to both ends of a tube a discharge will still take place from each end, and there will be a dark space in the middle, the electricity here seeming to turn back again the way it came. The discharge from a pole through a vacuum tube would therefore appear to be not akin to conduction, but to a disruptive discharge. It is a leap in the dark, and the phenomena observed are due to the gaseous nature of the medium. These experiments point to the possibility of completing a circuit by positive electricity alone. Prof. Guthrie suggested that by combining vacuum tubes with the conduction balance of Prof. Hughes it might be possible to get an optical balance for measuring inductive capacity.

Dr. HENRY DRAPER, of New York, who is now on a visit to England, then addressed the meeting on his alleged discovery of oxygen in the sun by bright lines in the solar spectrum. He said that hitherto he had not been able to find these lines projecting from the limb of the sun, like hydrogen, and his impression is that oxygen resides lower than the reversing layer. He had lately been extending the dispersion of the spectrum of terrestrial oxygen, and from a light of maximum intensity of 1 candle power had now got a dispersion of eighty inches from A to O. He exhibited two of the original negatives of the solar spectrum showing the bright line.

MR. J. NORMAN LOCKYER congratulated solar science on having so able a worker as Dr. Draper, and remarked that if Dr. Draper proved his case for even two or three O lines it would be sufficient, considering the variability of the spectrum of matter under different physical conditions. He also alluded to the traces of carbon which he himself had found in the sun by the dark flutings in the spectrum.—Dr. Draper said he did not see why carbon should not give both bright and dark lines. Mr. Scott exhibited a number of coloured photographs done after the method of M. Albert, of Munich.

AT an extra meeting of this society, held at Coopers' Hall Indian Engineering College, on June 21st, Lord Rosse in the chair, Prof. UNWIN read a paper on "The Friction of a Solid Moving in a Liquid"; and Lieut.

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G. S. Clark, R.E., described an "Optical mode of Determining the Absolute Pitch of Tuning Forks."

Prof. MACLEOD then described an electric pendulum used in the foregoing experiments. The zinc and steel communicating pendulum moved by its own gravity, but at each swing it made and broke a current by means of two bent springs, one on either side. The current passing through an electro-magnet detains a bent lever until the pendulum swings to the other side. By this contrivance the time is marked. Prof. Macleod found that the platinum contacts frequently stuck together in these experiments; but this defect had been cured by the use of a liquid shunt of dilute sulphuric acid, which destroyed the extra current. This remedy had been suggested to him by Lord Rayleigh. Prof. Macleod demonstrated the entire success of this device, which acts as well as a condenser shunt. He has also observed a curious effect with these liquid shunts which, as yet, he could not explain. Two shunts, having the same acid in both, were employed, one shunting the extra current from four Daniell cells, and one that from two Daniel cells. The first showed evolution of H and O, gas platinum electrodes being unaffected. The second showed no evolution of gas, but one platinum plate was dissolved away and deposited in a black powder on the others. He also exhibited a new cell formed of zinc and mercury plates with zincic iodide solution and mercurous chloride salt. Red iodide is formed at the negative electrode. The E. M. F. is $\frac{1}{10}$th of a Daniell cell, but the internal resistance is very low, and the cell very constant, while there is no local action.

Prof. GUTHRIE suggested that as the extra current was really a succession of sparks, the platinum might be carried bodily over from one electrode to the other. Mr. F. H. Varley stated that Mr. F. Higgins had observed a similar effect with carbon electrodes in a voltameter, one carbon falling away into a fine powder, and due, perhaps, to the disintegrating action of liberated gases. He had also himself seen a platinum wire in contact with a carbon, one eaten thin and drawn into very fine silky pen s, while carbon was stained blue, although the current passing had very low tension. Mr. Chandler Roberts suggested that perhaps a hydride of platinum was formed in the cases mentioned by Prof. Macleod. Prof. Guthrie suggested experiments with fluorescent liquid shunts in the dark.

Mr. J. W. CLARK then described some experiments on the surface tension of liquid sulphurous anhydride, sealed in a capillary tube within a second tube containing the same substance. He found that at low temperatures the level of the liquid is lower in the narrow than in the wide tube. As the temperature rises the meniscus in the narrow tube descends till about 156° F., then it is level with that of the wider tube; both surfaces are slightly concave at this temperature. The surfaces become plane, then convex, the level in the wide tube becoming higher as the temperature rises higher. These experiments are being continued, and his other results, will be communicated to the society.

Prof. GUTHRIE proposed a vote of thanks to Col. Chesney, principal of the college.

General Science.

TEMPERATURES OF LUMINOUS SOURCES.—According to the researches of Draper and Becquerel, when the temperature of an incandescent solid continuously increases its spectrum lengthens out at the violet end. This fact, therefore, furnishes three modes of measuring the temperature of the luminous source—(1) by the wave length of the radiation which limits the spectrum towards the violet; (2) by the position of the thermal maximum of the spectrum, which approaches to the violet in proportion as the temperature of the emitter becomes higher; (3) by means of the ratio of the luminous intensity of a determinate radiation λ taken in the spectrum of the source, to the intensity of the same radiation in the spectrum of a source of known temperature, compared with the ratio of the luminous intensities of another radiation λ^1 in the same two spectra. Following these methods, M. Crova has recently compared the lights from the moderator lamp, the stearine candle, gas, lime light, electric light, and solar light, and he finds that the intensity of these lights weakens toward the violet rays in the order in which they are given, that is, when the intensity in the red rays is the same for all.

THE LIGHT REQUIRED BY GROWING PLANTS.—The recent researches of M. Best into this subject have demonstrated that the kind of light which fosters the growth of plants is that mapped out by the various absorption bands of the spectrum of chlorophyll, the green colouring matter of leaves. In his experiments M. Best found that plants kept under a green glass shade soon died, whereas those kept under red glass shades survived. Hence it appears that the light essential to the growth of plants must come from red rays, which are absorbed by the green glass. Also when green chlorophyll solution was substituted for the green glass the plants quickly died. In connection with this subject it has been pointed out by Mr. J. Munro that a great proportion of our common trees have the outer surfaces of their young leaf cases coloured a bright red, apparently for the purpose of turning them into light screens, which would allow those rays of the spectrum to pass which were favourable to vegetable growth, and quench those which were against it. From the researches of M. Yung it would also appear that whereas red light favours plant life it is pernicious to the life of animal germs, such as the spawn of frogs, the violet rays favouring the latter most.

OBSERVING FLASHING LIGHTS.—MM. Richet and Antoine Breguet find from experiment that there is a certain inert period before which the eye becomes sensible of lights. If the light is very brilliant like the electric spark this time is not appreciable, but for feeble lights it is observable. Feeble lights, lasting $\frac{1}{1000}$ of a second are not visible at all; but they can be rendered so either by increasing the intensity of the light or its duration, or by repeating it at least 50 times a second. Coloured lights obey the same laws and always appear of their proper hue.

GLAZED FROST.—This interesting natural phenomenon, which although frequent enough in Canada is very rare in Europe, was witnessed lately in the North of France. It is caused by freezing after a thaw, or by the immediate freezing of falling rain as in this case. In the forest of Fontainebleau great havoc was caused amongst the trees by the breaking of their ice-laden branches. Trees about a foot in diameter were completely crushed down by the weight of ice which they bore, and the damage is estimated at a million and a half francs. To give some idea of the effects produced, it is sufficient to cite the fact that a bough of ice-coated rhododendron which weighed 360 grammes, weighed, when thawed of its covering, only 13 grammes. Some of the grasses and plants sealed in their crystal cases were very curious and pretty. The telegraph lines were broken down at a number of points, under the weight of ice which encased them with a regular cylinder of ice 38 millimetres in diameter.

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THE PLATINISATION OF IRON.—The incorrosive nature of platinum is well known, and its application to iron surfaces as a preservative from rust, is a problem which has long engaged the attention of metallurgists, though hitherto without any practical result. Monsieur J. B. A. Dodé, an eminent French chemist, claims to have solved this problem. He first paints the iron over with a composition of turpentine, borate of lead, oxide of copper and cobalt, and exposes it for a few minutes to a temperature of about 400 degrees. On cooling, the surface is again painted with a solution of chloride of platinum, combined with essential oils, and the object heated for a second time. When cool it is found to be covered with a permanent and homogeneous coating of platinum, rendering it impervious to rust, and unaffected by gas, atmospheric changes, and ordinary wear and tear. The gist of the discovery lies in the method of dissolving and holding the platinum in solution, and in applying it direct to the article treated, without any other aid than so low a temperature as not to affect the metal coated. The process, which is eminently suited for the preservation of telegraph wires and apparatus, has just been successfully carried out in London, and finished specimens may be seen at 18, Queen Victoria Street, E.C.

AN ELECTRICAL RAILWAY.

ONE of the most interesting novelties in the Berlin Exhibition is the construction of an electrical railway by Siemens and Halske. The electrical power is supplied by a dynamo-electric machine worked by a steam-engine to another dynamo-electric machine, which works the wheels of an electric locomotive. The length of the way is 200 metres, the velocity 3 metres per second; the number of waggons 3, and passengers 20. The same experiment will be tried at the Scientific Exhibition at the Paris Palais de l'Industrie, with Marcel Deprez's motor, which is very promising. A new model has been constructed, weighing seven kilograms, and with 12 Bunsen elements can give a man-power. This model of Marcel Deprez's is exhibiting now at Lille, on the occasion of one of the ascents of the Aëronautical Academy. It is hoped that it will have force enough to work an aërial helix for ascending and descending without any sacrifice of ballast and escape of gas.—*Nature.*

AUSTRALASIAN TELEGRAPHY.—Of the 588 miles of electric cable to be carried out by the steamship *Scotia*, in order to continue the line of telegraph already complete from Penang to Malacca, and thence laid nearly as far as Singapore, the end was wound on board on the 25th ult., from the Telegraph Construction and Maintenance Company's Works at Greenwich. This fine vessel of 4,600 tons, formerly a paddle ship in the Cunard fleet, and since altered to a double screw, with an additional deck, measures 379ft. in length, her beam being 48ft. She has engines of 500 horse-power, and her speed is 13 knots. A large company of guests, including many representatives of foreign countries, who are assembled to take part in the International Telegraph Congress, went down from Westminster Pier on a river steamer, and boarded the *Scotia* during one of the heaviest showers of the day.

The following are the final quotations of telegraphs for the 26th ult.:—Anglo-American, Limited, 55-55½; Ditto, Preferred, 84½-85½; Ditto, Deferred, 27-27½; Black Sea, Limited, —; Brazilian Submarine, Limited, 6½-7½; Cuba, Limited, 8¼-8¾; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10¾-11¼; Direct United States Cable, Limited, 1877, 10¼-10¾; Eastern, Limited, 7⅞-7⅞; Eastern, 6 per cent. Debentures repayable October, 1883, 104-107; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11⅛-12; Eastern Extension, Australasian and China Limited, 7⅞-7⅞; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; German Union Telegraph and Trust, 7¾-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10⅛-11⅛; Great Northern, 8⅛-8⅛; Indo-European, Limited, 20½-21½; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 8¾-9¼; Reuter's, Limited 9-10; Submarine, 225-235; Submarine Scrip, 2-2½; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅛-1⅛; Ditto, 6 per cent. First Preference 8-8¼; Ditto, ditto, Second Preference, 7½-7¾; Western and Brazilian, Limited, 3⅛-3⅜; Ditto, 6 per cent. Debentures "A," 96-100, Ditto, ditto, ditto, "B," 88-93; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 115-120; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 31-31½; Ditto, 6 per cent. Bonds, 109-111; Ditto, Second Bonus Trust Certificates, 2⅛-2⅛; India Rubber Co., 12½-13; Ditto, 6 per cent. Debenture, 105-108.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,509,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
May, 1879 ...	47,910	*12,810	3,100	984	15,970	38,371	25,845	18,917	... ...	11,452	... ...	124,30	5,526
May, 1878 ...	42,990	12,564	3,254	816	11,650	33,650	23,844	19,463	... ...	10,584	1,450	10,652	5,769
Increase	4,920	246	... ...	168	4,320	4,721	2,001	... ...	... ...	868	... ...	1,778	... ...
Decrease	... ...	... ...	154	... ...	... ...	... ...	... ...	546	... ...	... ...	... ...	... ...	243

* Four weeks against calendar month of last year.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness).

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 155.

WILLIAM FOTHERGILL-COOKE.

ON the 25th of June, Sir William Fothergill-Cooke died at Farnham, in the seventy-third year of his age. Born at Ealing in 1806, he was educated at Durham University, where his father gave lectures on physiology, besides practising as a physician in the town. From Durham young Cooke was sent to Edinburgh University, and subsequently, in his twentieth year, he went to India, in the service of the East Indian Army, where he held several staff appointments.

Five years later, in 1831, he returned to Europe, and devoted himself to the study of anatomy and physiology at Paris and Heidelberg; but being one day, in March, 1836, in the lecture-room of Professor Moncke, he witnessed the operation of an experimental telegraph which the professor was exhibiting to his class, and from that hour the whole course of his life was altered. The young Indian officer and medical student had at that early day not occupied his mind with the new electrical researches which were engaging the minds of natural philosophers, but Moncke's experiment brought them before his notice, and henceforth he forsook all his other studies in order to develope the electric telegraph and make it the practical instrument which he believed it could be made. While others were toying with the new invention, Cooke took it up in grim earnest, and, three weeks after seeing Professor Moncke's illustration, he had devised a practical working telegraph based on the same principle, namely, the electro-magnetic discovery which Oersted had made, and Gauss and Weber had applied in their experimental line between the University and the Observatory of Gottingen. This plan of Cooke's included a key for interrupting the circuit, a battery, and three separate wire circuits, each having a going and returning wire, and a rough galvanometer or needle instrument, while a kind of switch was also employed to change the connections. The same year he also invented an ingenious mechanical telegraph, in which the current, by means of an electro-magnet, released a rotating drum set with pins, like the barrel of a musical-box, and moved a dial-plate marked with letters and figures until one of the pins made a contact and broke the circuit, when the dial came to rest exposing the desired signal letter to view. Applying this apparatus he met with a difficulty in determining the strength of current necessary to operate the electro-magnetic detent, and, after consulting Faraday and Dr. Roget, he referred himself to Professor Wheatstone, who was then engaged in electrical researches at King's College. Their meeting took place on February 27th, 1837, and Wheatstone showed him an experimental line which he had also fitted up on the Oersted principle. Cooke soon induced Wheatstone to join forces with him for the production of a practical public telegraph, and they entered into a partnership with Mr. Ricardo, M.P. Their first patent was dated June 12th of the same year, and it described the original five needle Cooke and Wheatstone instrument, so well known to every electrician, with its upright diamond-shaped face and five needles. Five circuits were necessary to work this apparatus, a fact which caused its final abandonment. It was tried first on the Great Western Railway, between the Paddington terminus and the West Drayton station, a distance of thirteen miles, in the winter of 1838-9, and opened for public messages. This was the first public telegraph in Great Britain, and as it was chiefly due to the ingenuity and enterprise of Mr. Cooke that it was introduced, he is well entitled to be called the father of English telegraphy.

In 1842 this line was extended to Slough, and became notable for the clever capture of a murderer named Tawell, by means of the five needle instrument now in the possession of the Post Office. Meanwhile other short lines had been erected, including one on the Blackwall Railway in 1841; and in 1844 the new telegraph was tried on a crucial scale upon a Government line from London to Portsmouth.

Mr. Cooke was honoured for his eminent public services with the Royal Albert medal of the Society of Arts in 1863. Three years later Her Majesty created him a knight in recognition of his great and special achievements in connection with the practical introduction of the electric telegraph; and, in 1871, he was granted a Civil List pension of £100 a year. His latter years were spent in seclusion, and he has passed away almost unheeded by the people at large: for, although his name lives in their memories, his work belongs now to the past, with that of Wheatstone and Morse.

MUIRHEAD AND WINTER'S QUADRUPLEX SYSTEM (FOR LAND-LINES).

As is well known, the solution of the problem of quadruplex telegraphy depends upon a successful system of "diplex" telegraphy, that is, a method of sending two messages in the *same* direction at the same time; this system being obtained, the duplexing of it is an easy matter. Messrs. Muirhead and Winter in their system of quadruplex

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FIG. 1.

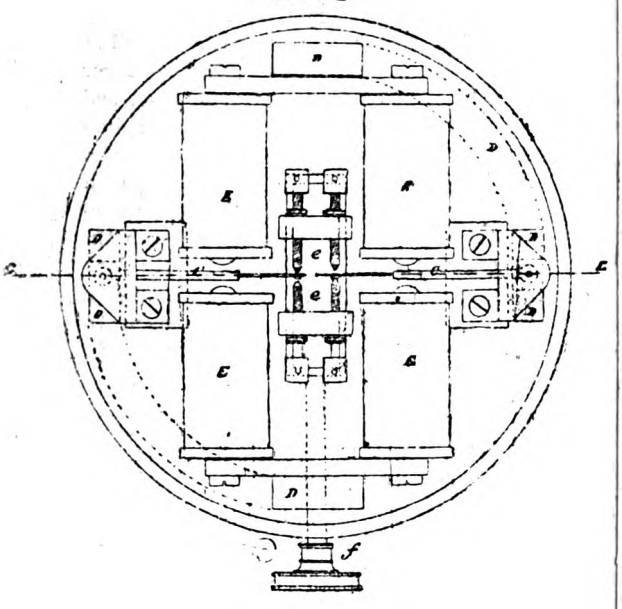


FIG. 2.
Section thro C. D.

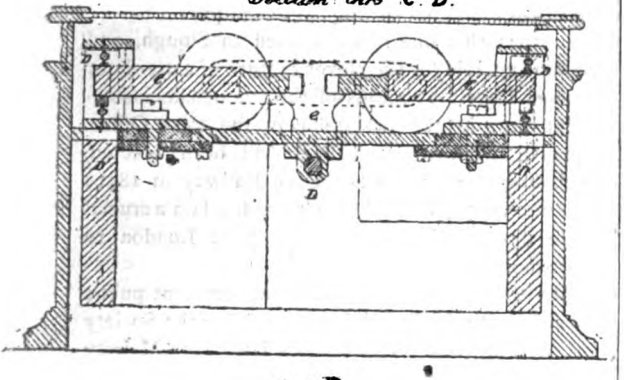


FIG. 3.

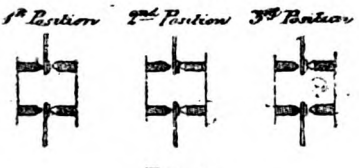
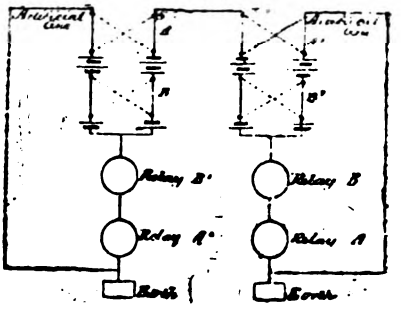


FIG. 4.



telegraphy have employed a somewhat novel method of "duplexing" their "diplex" system, which is worthy of publication.

In the diplex arrangement at the transmitting station the two keys are so arranged in connection with batteries that in the several positions of the keys the battery strengths flowing out to the line are as follows :—

Both keys at rest,	+ 3
Key B depressed, A at rest,	+ 1
Both keys depressed,	— 1
Key A depressed, B at rest,	— 3

The arrangement of the keys and connections by which this is effected will be described further on.

At the receiving station there is a polarised relay adjusted to break the local circuit when the current is plus, and to complete it whenever the current becomes minus; a local sounder or other receiver connected with this relay records the depressions of key A.

There is also in the main current at the receiving station a double tongued relay, which is used for completing the circuit of the sounder or receiver intended to respond to the movements of the key B.

This double relay, which forms an important feature of the system, is so arranged that in order that the local circuit should be completed, it is necessary for both tongues to be against their respective contact points. To accomplish this either the tongues are insulated and the contact between tongue and tongue caused to be completed through the contact points, which in this case are connected electrically with each other, or the contact points are insulated and the contact between point and point is completed through the tongues, which in this latter case are of course connected together.

The polarity and adjustment of the tongues is so arranged that the contact between one tongue and its point is only broken when the current is + 3, and that between the other tongue and its point is only broken when the current is — 3. With the intermediate strengths of + 1 and — 1 both tongues are in contact with their points, and the circuit of the relay is complete. Thus the local circuit is broken when the current is either + 3 or — 3, but it is closed when the current is either + 1 or — 1.

Both the contact points are fixed to the same carrier, and the arrangement is such that when once the contact points have been individually adjusted, their further adjustment for ordinary changes in strength of the currents is made simultaneously by one and the same motion of the carrier.

Figs. 1 and 2 represent respectively a plan and section of one form of the double tongue relay. In this form the tongues C C are polarised with like polarity by the permanent magnets D D. The tongues are insulated from the framework of the relay and from each other, and contact between them is established when both tongues are against their respective contact points, which are fixed to a single carrier and on one side of it; the screws on the other side of the carrier have insulated points.

The electro-magnets E, E, E, E, are polarised by the ends of the permanent magnets D D, the other ends of which polarise the tongues, so that all four poles of the electro-magnets have the same polarity.

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The result of this arrangement is that, when the relay is acted upon by the currents + 3, + 1, and — 3 respectively, the tongues take up the respective positions shown by fig. 3.

After the first adjustment of the tongues, their further adjustment is made by moving the whole carrier *e e*, by means of the slow motion screw *f*, which works in a nut underneath the carrier.

It is evident that the action of any current passing through the coils of the electro-magnets, which are wound in the usual manner, is to cause the electro-magnets to act oppositely on the two tongues in consequence of the opposite polarity; thus, if a plus current tends to cause the one tongue to move in the direction of its insulated point, a minus current will have the same effect on the other one. The adjustment of the tongues is such that it requires a strength of + 3 to act thus upon the one tongue, and — 3 to act in the same way on the other tongue. If the current has either of the intermediate strengths of + 1 or — 1, the strength is insufficient to move either of them against the bias given them against their contact points, and consequently both tongues are in contact with their respective contact points, and the local circuit of the relay is complete. When the current changes rapidly from + 3 to — 3, the one tongue leaves its contact point before the other tongue has time to make contact. It is only when this change is retarded that any difficulty is experienced in working the local instrument B direct with this relay. If the instrument is a recorder the signals are perfect, as the effect of retardation is only to cause a slight trembling of the armature against its upper limiting stop, and is insufficient to affect the record. With sounders this is an inconvenience which can be remedied by using an extra local relay to complete the circuit of the sounder, the local circuit through the coils of which extra relay being completed by the double relay described.

In duplexing the "diplex" system a method of "double substitution" is employed. This system consists in placing the battery between the true and artificial lines, and connecting the receiving apparatus between the middle of the battery and earth. In order to give a signal the battery is reversed. Thus supposing copper to be connected to the true, and zinc to the artificial line, while the key is at rest, the depression of the key will join zinc to the true and copper to the artificial line.

In this arrangement perfect balance is obtained when the true and artificial lines are equal, and balance is perfectly independent of any changes in the resistance and electro-motive forces of the two halves of the battery, any inequality in which will merely cause a current to flow through the receiving instrument, but which current will remain the same whether a signal is being sent or not, that is, whether the battery is direct or reversed. The arrangement will be understood from fig. 4.

In this arrangement the keys B and B^1 separate the batteries into two portions, one of which contains $2n$ cells, and the other n cells. When these keys are at rest the connections are along the continuous lines, and the two portions of the batteries are acting in the same direction, so that the current is $2n + n = 3n$. When these keys are depressed they reverse n cells of the battery, so that there are only $2n - n = n$ cells acting. The keys A and A^1, when depressed, simply reverse the current, whether it is $3n$ or only n as before.

It will be seen that as far as the receiving instrument and batteries are concerned it is really the true and artificial lines which are affected by the reversing key. They mutually replace one another in two portions of the circuit external to the instrument and batteries. There has, therefore, been given the name of "double substitution" to this form of duplex working, which, although similar in appearance to the split battery system, differs from it essentially in principle, for whereas in the split battery system balance depends on the maintenance of a strict proportion between the electro-motive forces of the two halves of the battery and the resistance of the true and artificial lines, the balance in the method of double substitution depends only on the equality of the true and artificial lines, which, however, experience shows may differ widely without affecting the received signals injuriously.

The principal merits claimed for this plan are,—

1. Its very wide working range. The artificial line may be altered within wide limits without affecting the signals.

2. The fact that the plan requires no special winding of the coils as in the differential system.

3. That the sensitiveness of the relay is not reduced, and magnetic retardation increased by the shunting action of bridge wires, as in the bridge span.

4. The balance, as stated above, is not disturbed by variations in the electro-motive forces or resistances of the two halves of the battery, as is the case in the ordinary split battery system. In addition to this, the action of the signalling on the distant instrument is of course doubled.

All that is necessary to neutralise any current which may be passing through the receiving instrument in consequence of inequality in the two halves of the battery is to join the receiving instrument slightly out of the centre of the battery. In order to do this effectually two or more of the middle cells of the battery may be shunted by a slide resistance equal to about three or four times the resistance of the cells so shunted, the receiving instrument being joined between the contact point of the slide and earth.

It will be noticed that the peculiarity in this quadruplex system consists in the duplexing portion and also in the form of double tongue relay. The arrangement of currents for the different positions of the keys is identical with that employed by Mr. Gerrit Smith, in America, but the latter gentleman employs his most ingenious, yet simple, compound relay, in the place of the double-tongued relay, and with great advantage.

THE NEW FORM OF LECLANCHÉ BATTERY.

By Dr. H. TOBLER, Professor of the Zurich Polytechnic School.

THE old form of Leclanché battery possessed, as is well known, a very considerable resistance, and the employment of a porous pot was subject to many inconveniences, which have prevented the greater employment of this description of battery. In the

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new and improved forms the inventor has dispensed with this porous vessel. The carbon electrode is surrounded with a mixture composed of 40 parts of pyrolusite, 155 parts of grain carbon, and 5 parts of resin, this latter substance acting as a cement. This composition is heated to 100° C., and subjected to a pressure of 300 atmospheres; it forms an homogeneous cylinder, in the axis of which is the carbon electrode. The inventor has given to this element the name of "conglomerate mixture" battery. These elements are extremely easy to manage; their electro-motive force is higher than that of the old form, and their resistance less. Under the influence of the current, the peroxide of manganese is reduced to the sesquioxide, a body which is not an absolute conductor of electricity. The conglomerate will then offer a more or less high resistance. Moreover, it fills up the pores of the conglomerate with considerable quantities of ammonia, which tends to decompose it. When completely exhausted, it becomes a useless mass, which is only fit to be thrown away.

M. Leclanché has recently devised a new modification, which is made by attaching to the carbon depolarizing plates which can be renewed from time to time. The two or three plates are simply attached to the carbon by india-rubber rings.

As regards the value of this new form of Leclanché battery, in the *Traite de la pile electrique* of Niaudet, the electro-motive force is set down as 1·6 that of a Daniell, and as regards its resistance, M. Barbier states that it exceeds that of an iron wire 400 metres long and 4 millimetres in diameter. The present investigation was made in order to determine the precise value of the battery.

Amongst the different methods devised for testing the resistance of galvanic elements, that of Mance is remarkable for the exactitude of the results it gives, and this was in consequence, the method chosen. In order to determine the electro-motive force, I have employed a condenser of ·5 microfarads' capacity, and have measured the discharge from it on a Thomson galvanometer.

Resistance Measurements.

I. An ordinary element of the No. 1 size, viz.: 140 millimetres high and 75 millimetres square, charged, according to the directions of the inventor, with 100 grammes of pure sal-ammoniac, and with water sufficient to three quarters fill the jar, gave a mean result of 1·131 S. U.

II. The same element, after working an electric pendulum on the Hipp system, and in which the current is broken during 80 or 90 seconds (resistance of electro-magnet 3 S. U.), gave a mean resistance of 1·513 S. U.

III. After an interval of two days, during which the element was not worked, the measured resistance was 1·153 S. U.

IV. Five old conglomerate elements were tested. These elements had been joined up at the end of December, 1878, and were since that date often employed for the measurement of the capacity of gutta-percha wires. The mean values attained were as follows:—

Element No.	1	...	...	2·52	S.U.
„ „	2	...	...	1·32	„
„ „	3	...	...	1·51	„
„ „	4	...	...	1·33	„
„ „	5	...	...	1·32	„

Element No. 1 had been employed frequently for working the electric pendulum before referred to. These experiments have confirmed the assertions of M. Leclanché that long use increases the resistance of the conglomerate.

V. A new element with moveable conglomerate plates. The height of the battery being 145 millimetres, and width 90 millimetres. Charged in the same way as the preceding one.

The measurement being taken about an hour after the liquid had been placed in the vessel, the resistance was found to be 1·370 S.U.

VI. The same element measured two days later gave ·736 S.U.

VII. The measurement being repeated a day later gave ·718 S.U.

Electro-motive force measurements.

As a standard I took a Daniell element, carefully prepared. The specific weights of the solution being kept as nearly constant as possible.

I. The element indicated under the previous headings I., II., and III.

1. Two hours after being charged, the electro-motive force was 1·46.

2. Two days later the result was 1·48.

II. The 5 old elements, indicated under the previous heading IV, gave the following results:—

1. Element No. 1 ... ... 1·43
„ „ 2 ... ... 1·32
„ „ 3 ... ... 1·51
„ „ 4 ... ... 1·33
„ „ 5 ... ... 1·32

2. Measurements two days later, the batteries having rested in the meantime:—

Element No. 1 ... ... 1·43
„ „ 2 ... ... 1·40
„ „ 3 ... ... 1·45
„ „ 4 ... ... 1·43
„ „ 5 ... ... 1·43

III. The element with renewable plates, indicated under the previous headings V., VI., and VII.

1. One hour after being charged

1·41.

2. Immediately after the measurements V. and VI.

1·38.

3. After the measurements VII.

1·40.

4. Three days after the measurements VII., the element not having been used in the interval

1·43.

It is certain from these experiments that the electro-motive force diminishes rapidly when the resistance is low, but that it recovers rapidly when the battery is at rest. The Leclanché element will not answer, therefore, for all purposes; thus, for example, the battery could not be employed on a closed circuit, or where the circuit is often closed. In other cases it is a useful battery, on account of its high electro-motive force and its low internal resistance.

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THEILER'S PATENT MECHANICAL DUPLEX (FOR LAND-LINES).

DUPLEX working either on the "differential" or on the "bridge" principle, is now universally known and understood, and if the essential features of those systems are referred to in the present article, it is only in order to show clearly in what respects this new duplex system differs from all others.

In both the differential and the bridge method, the current is split between an actual and an artificial line; and it is absolutely necessary that a certain ratio of current be kept up between the two circuits so as to produce a "balance." But, considering that the resistance and the electrostatic capacity of a line, from a multiplicity of causes, varies constantly and considerably (in bad weather the resistance may vary as much as 50 per cent. in one day), and that variation in the resistance and static capacity of the line means alteration in the adjustments of the apparatus, it must be conceded that duplex working, either on the differential or bridge principle, looks simpler on paper than it is found to be in practice.

In Theiler's mechanical duplex, the current is not split between two circuits, and as no equality of currents has to be maintained, variation in the resistance of the line, be it even as much as 100 per cent., does not affect the apparatus. There are no condensers, no rheostats, and the only adjustment required is that of the relay, just as in ordinary single working.

An explanation of the diagrams fig. 1 and fig. 2, which represent the *theoretical* construction of the apparatus, will show how signals, electrically neutralised by simultaneous sending from opposite stations, are recorded mechanically.

The key lever *e*, whose motion is limited by the stops *a*, *b*, carries a spring *f*, which is insulated at the point where it is fixed to the lever of the key which touches this lever at the extremity *h* of the latter. This spring impinges on the tongue *l* of the polarised relay *m*, *m'* when the key is depressed, but does not touch *l* when the key is at rest. The (polarised) relay may be of any form, but is preferably a "Theiler's,"* as that construction allows of a convenient and nice adjustment of the electro-magnet. The armature (which is induced at the centre *c*, so that both ends have similar polarity) is adjusted that the tongue *l* has a bias towards stop 2, stop 1 being in connection with the receiving instrument, Morse or Sounder.

Now when one of the keys (connected to earth) is depressed upon the front stop *b*, as shown in fig. 2, the end of the spring *f* touches the tongue *l*, and meeting an obstacle bends, and thereby breaks contact with the lever at *h*, consequently a current flows from the copper pole of the line battery through the tongue *l*, the spring *f*, the electro-magnet *m*, *m'*, to line, and entering the relay of station II. returns through the spring *f* and the lever *e* to earth.

The effect of this current upon the relay at station II., is an *increased* pressure of the tongue *l* against stop 2, which resists all tendency of the spring *f* to move the said tongue against stop 1,

* See TELEGRAPHIC JOURNAL, Vol. V., page 207.

FIG. 1.

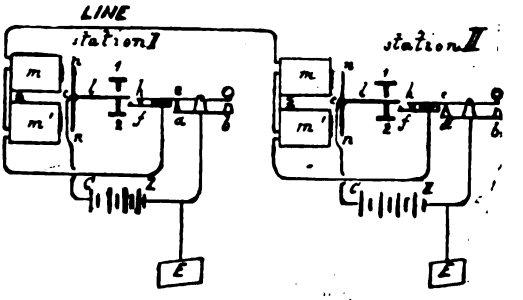


FIG. 2.

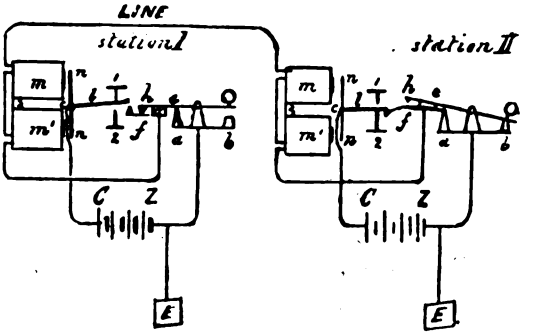
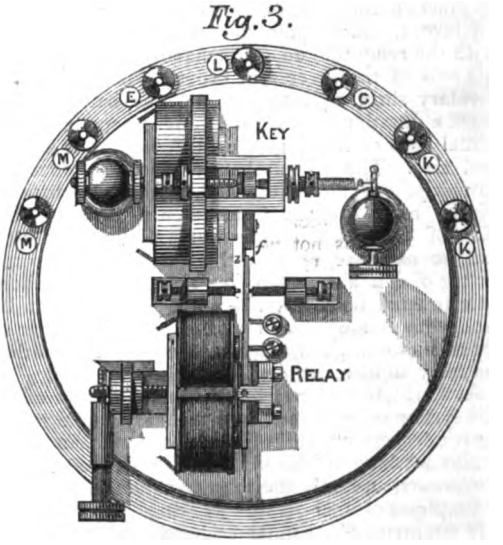


Fig. 3.



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while the effect of the current upon the relay of the receiving station is exactly reversed, the current entering *m*, *m'*, from an opposite direction and causing the tongue *l* to move against the marking stop 1. Thus the outgoing current does not move the relay tongue of the sending but only of the receiving station. As both stations are connected exactly alike, the same thing will happen if station I. sends and station II. receives, both being in position to receive when at rest. It will be seen that every depression of the key tends to move the relay tongue mechanically towards stop 1, and is only prevented from doing so by the magnetisation of *m*, *m'*, which takes place the instant *f* touches *l*, and whereby the tongue is forced against stop 2.

If no current were to flow through the magnet of the sending station relay, then the key would produce its signals at its own station. Such is actually the case when both stations send simultaneously. Then the copper pole of station I. opposes the same pole of station II., and contact with earth being broken, no current goes to line; nothing now counteracts the tendency of spring *f* to push the relay tongue against the marking stop 1, and thus, in the absence of any current, the signal sent by station I. is recorded by the mechanical actuation of the relay tongue at station II. by the key of the latter station, and *vice versâ*.

But the instant the key, say at station I. falls back while that at station II. remains depressed, the relay tongue of station II. also falls back, because the returning magnetization of that station's relay will overpower the pressure of the spring *f* and force *l* against stop 2, while the relay tongue at station I. will remain against stop 1 without any assistance from the spring *f*, because the direction of the current tends to keep the tongue on that side.

The actual construction of the apparatus differs somewhat from that illustrated by figs. 1 and 2. In order to render the motion of the lever *e* exact, decided, and as small as possible, it is preferable to effect it by means of an electro-magnet, and to use an ordinary key merely to make and break connection with that electro-magnet and a local battery. In practice, the point of contact of the spring *f*, with the lever *e*, and the point of contact of the said spring with the relay tongue *l* are made equidistant from the axis of the lever *e*, in order to make the momentary short circuiting of the line battery of as short a duration as possible. Fig. 3 represents the actual form of the apparatus, three-quarters of the real size. The adjustments of the key, once set correctly, are never touched, while the distance of the relay magnet from its armature and the bias of the relay tongue against the next stop can be easily regulated; the tension of the line spring *f* can also easily be altered; both these adjustments, however, need but very seldom be touched. A loop circuit of 200, and afterwards of 400 miles were, for instance, worked without altering the relay adjustment.

As the static charge from the line does not affect this system more than it does, ordinary single working condensers are entirely dispensed with, and thus duplex working on this system with no rheostat, no condensers, and only the relay to adjust, is rendered as simple as ordinary single working.

In countries like England where duplex working has been extensively established for some time, and a change in the present system would necessitate change in a large stock of duplex apparatus, it will be difficult, perhaps, to get adopted *any* new duplex system until increased traffic calls for a greater number of duplex circuits.

But in countries where duplex working is only just gaining a footing, this mechanical duplex ought to have a splendid field. From its simplicity the system, also, appears particularly applicable to military field telegraphy. Where telegraphic lines are very long, two sets of the above apparatus, suitably connected to the "up" and "down" line, are used to act as a duplex translator.

We understand that the inventors of the Mechanical Duplex will shortly bring out a duadruplex on a similar principle.

LIGHT FROM ELECTRICITY.

WHETHER the electric light be produced by incandescence, or by the voltaic arc, the problem of producing a satisfactory result consists in the first place of arranging all the effective resistances that the maximum possible portion of the total heat generated in the circuit may be made use of.

Now, when the flow of electricity has become steady, and in the case where the positive electrode is in a condition to remain in a state of dynamic equilibrium, or is in a condition so to modify constantly the variable elements as to practically produce a state of equilibrium, then the body of which the resistance is formed takes an equilibrium of temperature corresponding to the luminous state, which is an exponential function of that temperature. This very rapid increase of luminous intensity with temperature is entirely in favour of powerful electric currents, and everything else being equal, to the disadvantage of division.

Supposing a table of luminous intensities corresponding to temperatures to be drawn up, the problem resolves itself into the determination of the temperature of the surfaces of emission. We must first endeavour to calculate directly this temperature by determining the number of caloric units generated in unit time in the effective resistance, by taking account of the mass of the working body, of its surface, of its caloric conductibility, of its specific heat at different temperatures, of the loss by radiation through particular mediums, &c.; but considering the numerous causes of error to which the introduction of so many elements, more or less doubtful would give rise, it would seem better to determine by direct experiment the temperatures to which the luminous emissions correspond in the particular medium, and to observe them at the moment when equilibrium will be established; the loss by radiation exceeding the loss by contact with the rest of the circuit in a second of time is precisely equal to the quantity of heat generated by the current in the working resistance. This quantity of heat being known, the expression of the emission as a function of the temperature allows of this latter being determined.

It seems, then, from recent researches, that the intensity of a radiation of a given refrangibility,

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caloric or luminous, does not increase indefinitely with increase of temperature, but only up to a maximum corresponding to a certain temperature, and decreases afterwards until it becomes insensible at a fixed point and also that it does not become appreciable until it reaches a certain temperature.

It is thus with the red light rays, which commence to be perceptible at about 500° C., and the light of which increases at first very rapidly up to about 1,933° C., the intensity then being 696 times as great as it is at 954° C. (the temperature of melting silver); after this a decrease takes place, and at 2,910° C., the intensity of these red radiations would not be greater than unity.

If a represent the intensity or the quantity of the total heat emitted by the unit of surface, then $\Sigma A a^t$ will be the sum of the intensities of all the radiations of the heat of different refrangibilities at the temperature t, each of the values of a decreasing with the temperature, in the proportion of $\log. a : m - nt$, a kind of compensation established by the predominance, more and more marked, of the terms introduced by the most refrangible radiations of which the exponential base is greater. It therefore follows that a formula of the form $A a^t$ can, in limits sufficiently broad, express the intensity of the entire radiations.

For a cylindrical surface of diameter d and length l, W being the quantity of heat generated in the working resistance, we have $W = \pi d l A a^t = B a^t$ from which

$$t = \frac{\log. W - \log. B}{\log. a}.$$

The temperature being determined, the total luminous intensity will be given by the formula $C c^t$, applicable to the luminous radiations of every refrangibility or by the known formula

$$\frac{f(t-\theta)}{b(e-1)}.$$

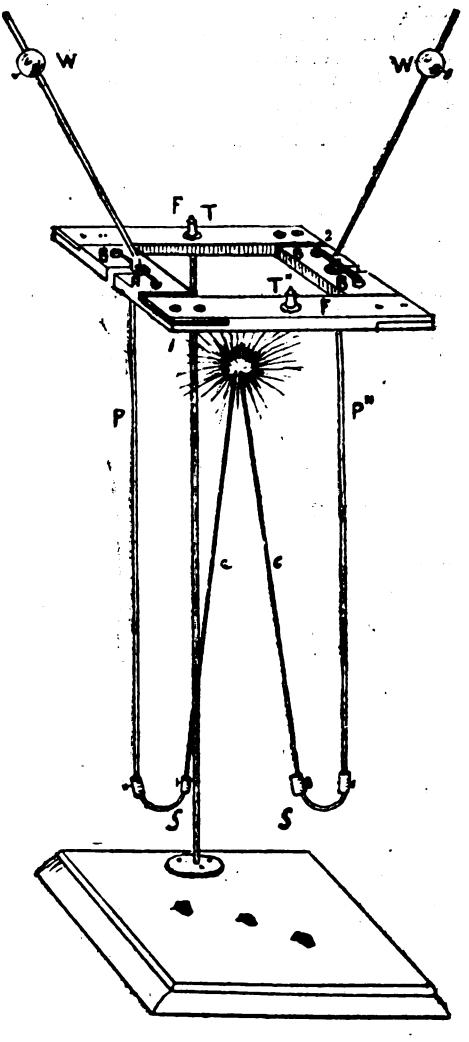
The ratio between the intensity thus determined and the mean intensity of a Carcel burner, for example, taken as a unit multiplied by the ratio between the projection of the light surface upon any plane and the projection upon a vertical plane, of the light surface of the unit lamp, expresses in Carcel burners and in the direction perpendicular to any plane considered, the lighting powers, to the naked eye, of the light considered.—*La Lumiere Electrique.*

HICKLEY'S ELECTRIC CANDLE.

THIS new repulsion lamp, or, more properly speaking, candle, is constructed upon the principle observed by its inventor, Mr. A. T. Hickley, Wilde, Jamin, and others, that the arc produced between two carbon pencils connected to an alternating current machine, causes the carbons to repel each other.

F, F is a brass frame made in two parts, each insulated from the other by ebonite or ivory at 1 and 2. Each piece is provided with terminals T, T″.

Two pendulums P, P″, swing freely in bearings B, B, B, B, which are in electrical contact with the terminals T, T″. These pendulums have levers at the top, upon which slide counterpoise weights w, w, which are held in their position by the thumb screws at their sides. Two carbons, 2oin. long, about $\frac{1}{8}$ of an inch thick, are secured to the arms at the bottom of the pendulums, and the weights w, w, so adjusted that their points just touch. As soon as the circuit is complete, the current passes alternately from one carbon to the other, producing the arc, which at once causes the carbons to repel each other, according to the power of the current.



As the carbons are consumed they become lighter, which has the same effect as though the counterpoise weights became heavier; and so the carbons are kept together in trying to touch each other with the same force as they burn down to the bottom.

Should one candle in a series become accidentally extinguished, the carbons of the whole series at once fall together, thereby closing the circuit, and re-establishing the light.

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An automatic switch can be attached to the axle of one of the pendulums at B, so that as soon as the carbons are nearly consumed the switch is liberated and contact is made between the two halves of the frame F, F, thereby cutting out that candle, but not interfering with the others which may be in circuit.

The rest of the drawing explains itself.

The form which we illustrate, was exhibited at the Royal Albert Hall in May last, and when connected to a Wilde's Alternating Machine (which was kindly lent for a short time), it burnt with great steadiness and brilliancy.

A number of these lamps may be put in circuit at once, for the weaker the current the closer the carbons fall together, but they are not extinguished, as would be the case were the carbons fixed in one position, as in the Jablochkoff's system.

EDISON'S ELECTRIC LIGHT.

MR. EDISON'S third London patent for "Improvement in means for developing magnetism and electric currents and in apparatus for illuminating by electricity," can now be seen at the Patent Office.

One part of the specification relates to an electric lamp or burner, made of platinum, platinum-iridium alloy, or other metal which fuses at a high temperature. This wire or strip is coated with an oxide of metal, such as cerium, zirconium, calcium, magnesium, or other metal or material which will not be injured by a high degree of heat. The effect of this coating is called "pyroinsulation." The wire or strip may be pyroinsulated by dissolving the oxide in an acid, coating the wire or strip with the solution, and then passing the wire or strip through heat from a flame or otherwise, to decompose the solution and cause the deposit of the oxide upon the wire or strip.

If the burner is made of wire, the latter after being pyroinsulated, is wound upon a spool or cylinder of lime, or other infusible material, and when the burner is placed in an electric circuit and the circuit closed, the electricity passes through the entire length of the wire of the burner and brings it to incandescence. The metallic oxide forms a pyroinsulating coating which protects the metal of the wire so as to render it more difficult to fuse, at the same time preventing the electric current passing from one coil to the next, thereby compelling the current to travel the entire length of the wire. If the burner is made from a strip of metal, the same should be thicker at one edge than the other, so that it may be coiled to an uniform thickness at the same time that it is rolled into a spiral. The strip of metal should be thin, so as to obtain considerable length in a short spiral. The spiral or helix thus made is pyroinsulated as aforesaid, and then compressed into a compact cylindrical form. Sometimes the pyroinsulating material is placed as a layer between the coils of the spiral or helix.

The thermal regulators set forth in "Edison's" British patent of October 23, 1878, may be used for regulating the current or burners made of a wire or strip of metal, coated with a pyroinsulating material for the purposes aforesaid. This pyroinsulating coating allows of very fine wire being used for the burner. Hence several layers of the wire may be wound upon the spool of infusible material, and the burner will have a resistance of several hundred ohms, which permits of several hundred burners or lamps being connected quantitatively in multiple arc, without requiring large main conductors.

In some instances a burner or candle is made of finely divided iridium, or other metal not easily fused, mixed with an oxide of titanium, iron, or other metal, which acts as a conductor when highly heated. This is to be moulded into the desired form, and, by properly proportioning the mixture, the current to the burner is regulated by the heat of the said burner, the resistance being lessened in proportion to the heat.

Another feature of this invention relates to the arrangement of the main conducting wires, so as to obtain a complete metallic circuit, and at the same time take advantage of the conductivity of the earth, so that the mass of metal in one of the conductors may be reduced. The earth and metallic conductor serve at the same time as a protection for the insulated conductors.

The magneto-electric machines may be of any suitable character and driven by power. They may be arranged between two main conductors in ranges or multiple arcs of three, four, or more in each, and the connections should be for intensity. One is a tube laid in the earth, and preferably of iron, and it forms, together with the earth, one half of the circuit; within this tube is the other, viz., an insulated conductor, preferably of a number of strands of copper twisted together in the form of a cable, one strand of the cable being dropped, say, every hundred feet, so that at the extreme end of the circuit there shall be but a single strand. This cable is insulated from the tube by any cheap or economical insulation, such as tar or asphaltum. A branch tube containing a single strand from the cable is to enter each house or building, and from the basement smaller wires are run to the various parts of the house where the lights are required. Each lamp is to be provided with a switch, so that it may be disconnected from the conducting wires.

The electric generators at the central station are provided with constant field-of-force magnets, the helices of which are in the electric circuit. Hence, if all the lamps feeding from the main conductors are disconnected by their switches, the circuit will be broken, and no current passes through the conductors leading from the station to the lights. Hence the steam engine driving the magneto-machines runs lightly, and with the expenditure of a very small amount of force. If now the switch of a single lamp is turned, the lamp is connected to the branch wires from the main conductors, the circuit is closed, and only sufficient current passes from the central station to supply that lamp, because the external resistance determines the amount of current.

In this way the current will be proportioned to the number of lamps in the circuit. Each lamp is preferred to contain a resistance, when incandescent, of 1,000 ohms. As before described, the connecting of one or more lamps causes a sufficient amount of current to be developed at the central station to keep the same incandescent. It follows that, if the machines at the station are arranged expressly for tension and quantity, many hundreds of lamps may be placed in circuit between the main conductors, the reduction of resistance upon placing each lamp in circuit drawing the proper quantity of current from the station. Hence the greatest economy possible is obtained by causing all the resistance outside of the main conductors to be light-giving resistances.

Another part of the invention relates to means for storing the electric current or energy, so that the same may be used as required. This is effected by the use of secondary batteries, and there are devices described for shifting the current from one secondary battery to another periodically, so that one may be in use while the other is being charged from the main circuit.

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The following are the "claims":—

1. An electric lamp or burner made of a wire or strip of metal coated with pyroinsulating material, substantially as and for the purposes specified.

2. The electric lamp or burner made of layers of metal with intervening pyroinsulation substantially as specified.

3. In combination with a burner formed of pyroinsulated metal, a metal case surrounding the burner, and made incandescent by the heat thereof substantially as specified.

4. The method of pyroinsulating the wire or strip of metal for the conductor, consisting in passing the wire or strip through a solution of lime, magnesia, or similar material, and then through heat from a flame to effect decomposition of the solution as specified.

5. The insulated metallic conductors within a metallic case which forms with the earth the return circuit substantially as specified.

6. The combination with electric lamps and a main circuit of two secondary batteries, and circuit connections and switch substantially as set forth to alternately change the main and secondary circuits substantially as specified.

7. The combination with a secondary battery and its enclosing case of a diaphragm, or similar device, acted upon by the accumulation of gas pressure, and a switch or lever moved by such diaphragm to disconnect the main circuit from the secondary battery substantially as set forth.

8. An electro-magnet in the same circuit as the lamps or burners in combination with an armature lever, latch, and contact piece substantially as and for the purposes set forth.

It is interesting to compare Mr. Edison's patent with that of Mr. St. George Lane Fox, No. 3988, of date Oct. 9, 1878, also 4043, of date October 12, 1878, abstracts of which are given on another page.

DISTRIBUTING ELECTRIC LIGHT.

MESSRS. MOLERA AND CEBRIAN, civil engineers, of San Francisco, have conceived the novel plan of dividing the electric light by optically reflecting the beams and dealing them out at the required points in the required quantity, thus saving expensive regulator lamps and electrical conductors. A full account of the system is published in the *Scientific American*, to which we are indebted for the accompanying illustrations.

Fig. 1.

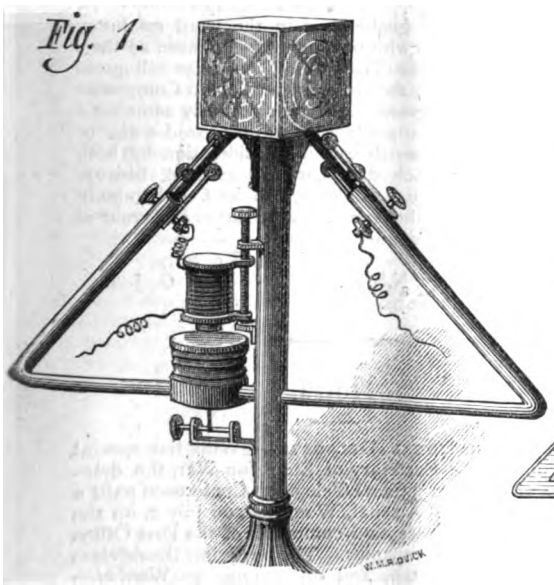
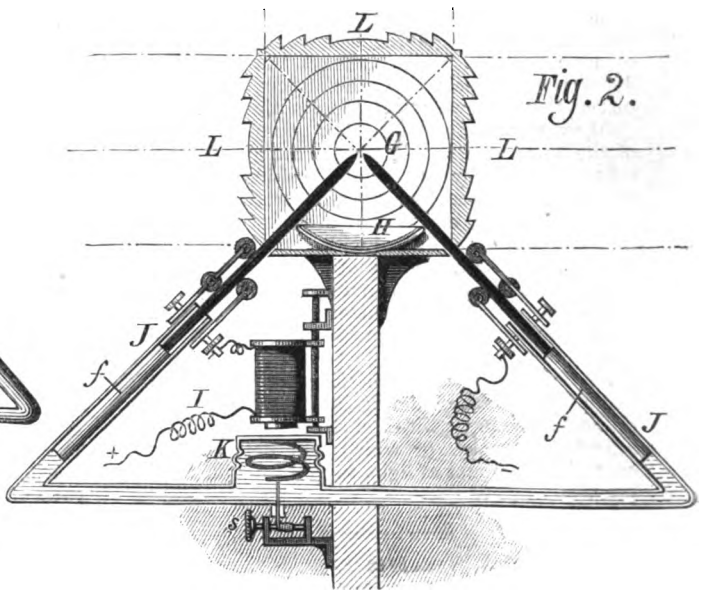


Fig. 2.



Messrs. Molera and Cebrian exhibit some very flattering figures based upon an expenditure of twenty horse-power, which, as we have already learned, is not sufficient to obtain the most advantageous results. They claim that they are able to produce by their system 195 lights per horse-power giving a light equivalent to 1,958 candles, and that the cost of lighting is less than one-twentieth the cost of gas.

The lamp used in connection with this system is so clearly represented in the engraving as to require little explanation. Fig. 1 is a perspective view, and fig. 2 is a vertical section.

Chamber G, which serves as a chamber of light, is surrounded on the sides and top by lenses, L. At the bottom there is a concave reflector, H, and at the centre two carbon rods converge. These rods are supported by pistons or floats in inclined tubes, J, which are connected at their lower ends by a horizontal tube communicating with the spring-acted bellows or cylinder, K. The tension of the spring that draws the top of the bellows down, may be changed by revolving the small windlass, *s*.

The top of the bellows is iron, and above it is supported an electro-magnet, which is in the

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electrical circuit. The carbons pass between conducting surfaces, and are also in the electrical circuit. The tubes J, as well as the horizontal tube and the bellows, are filled with a suitable liquid. As the current passes from one carbon point to another the core of the electro-magnet becomes magnetised and attracts the head of the bellows with more or less force, maintaining a uniform light by governing the distance between the carbons by displacing the liquid in the tubes and throwing the pistons or floats up or down, according to the strength of the current.

Should the current cease the spring draws down the head of the bellows and the points of the carbons touch. When the current is too strong, the top of the bellows is attracted upward, and the carbons separate.

A single electric lamp placed near the current generator supplies light for a building or a street. This lamp is surrounded by a system of lenses and reflectors forming the chamber of light, as represented in Figs. 1 and 2. These lenses concentrate the whole of the light into as many beams of parallel rays as there are faces in the chamber. In this form the light may be projected through long distances. The intensity of the light when not condensed is inversely proportional to the square of the distance from the source of light, but when the light is projected in parallel rays and is prevented from radiating, its intensity remains unchanged, except perhaps a small loss by the absorption of the atmosphere.

From every face of the chamber of light a box or pipe projects, which incloses the light beam. These pipes are laid along the streets, and they are placed along the walls and floors of the building.

At every side street a smaller pipe branches out of the main one, and at their junction there is a reflector, which by its size and position, will divert into the side street any desired percentage of the entire light. By means of this device every street in a city may be provided with one or more pipes carrying a certain amount of light that is always controllable by merely changing the position of the reflectors. This arrangement may be compared to the valves and water gates of a system of water distribution.

Service pipes lead from the street pipes to the lamppost and to the buildings, and at the intersection of the service pipes with the street mains there is a reflector, the size of which will determine and control the amount of light supplied by the service pipe.

Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—The telegraphic instrument described in your Journal of April last as the invention of M. Bramão, of Portugal, is but an elaborate modification of an apparatus designed to effect precisely the same end, and patented in 1854, by J. W. Wilkins, of Hampstead.

But for the mistake of launching a company (although the solicitors were Mansfield and Fews, and such names as Leaf and Rolt were on the Directory) in face of the Crimean War, the English patent would doubtless have been sufficiently well known, as not to admit of its re-introduction to-day as a Portuguese invention.

July 4th, 1879. JUSTITIA.

THE INTERNATIONAL TELEGRAPH CONFERENCE.

SIR,—As there is some likelihood of a letter tariff being introduced at the Telegraphic Conference, to be held in London shortly, may I beg to draw your attention to the orthography of our language, which will, unless some provision be made for it, cause a deal of bother both for the Telegraph Companies and the public.

Dictionaries are at variance about such words as smalness—smallness; fulness—fullness; talness—tallness: miscal—miscall; enrol—enroll, &c., &c.

There is also a rule grossly violated by us to the effect that "words of more than one syllable, with the accent not on the final one, preceded by a single vowel do not double the final consonant before a vowel augment," *e.g.*—canceled, traveling, always spelt with two *l's*. This rule is seldom violated by Americans.

Should this letter tariff come into force, it will bring about a thorough overhauling of the rules of orthography, therefore, something should be done at the coming Conference to alleviate as much as possible this rather important question, which will inevitably arise between the public and the Telegraph Companies.

The public will gladly hand in the word smalness, and similar words with one *l*, quoting Johnson as their authority, whilst the Telegraph Companies will quote Webster as theirs; therefore, let public and Companies come to some agreement about rigorously adopting a dictionary for their guidance, and thus avoid a deal of confusion. It is worth careful consideration by both parties as to which dictionary be adopted, because Johnson, Walker, and Knowles, will be found to be in favour of the public, and Webster rather in favour of the Telegraph Companies.

I am, Sir, &c.,

Botany, Sydney, N.S.W. G. J. B.
May 12th, 1879.

Notes.

THE INTERNATIONAL DELEGATES.—With the special sanction of the Secretary of State for War, the delegates of the International Telegraph Conference paid a visit to the Royal Arsenal, Woolwich, on July 2, on the invitation of the reception-committee of the Post Office and Telegraph Companies. The party left Blackfriars pier at half-past ten, and on arriving at Woolwich Arsenal were met by the heads of the departments, and were conveyed by the local railway to the Government marshes, where they witnessed the running of the fish torpedo in the Arsenal canal, and several important experiments with gun cotton. The visitors inspected the new 100-ton gun, and witnessed the firing of the Woolwich Infant. It was arranged that they should see the military balloon equipment; but a boisterous wind and a heavy thunderstorm prevented this being carried out. The party then partook of luncheon in the Carriage Department New Store, at which Sir James Carmichael, Bart., presided. They subsequently visited the Royal Gun Factories, Shell

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Foundry, Royal Carriage Department, Royal Laboratory, and returned by steam-boat to London in the evening.

On the preceding Friday, June 27, the delegates visited Windsor Castle, and were afterwards entertained by Sir Daniel Gooch, M.P., at luncheon in the Windsor Town Hall. The unprecedented bad weather has, we regret to say, materially interfered with the enjoyment of the delegates; but by all accounts it is not confined to England alone, although we have certainly come in for the lion's share of it.

A CONTEMPORARY has published a translation of an article from a French paper stating that it requires six 18 h.-p. engines to drive machines for supplying 60 Jablochkoff lights. Against this we have it on good authority that recently a 20 h.-p. (nominal) Ransome's engine supplied 60 Jablochkoff lights on the Thames Embankment, and this for a period of three consecutive hours.

THE ELECTRIC LIGHT.—The Bill before the House of Commons, promoted by the Liverpool Corporation to give power to adopt and supply electricity for private and public lighting was petitioned against by the Liverpool Gas Light Company in Committee. It was, however, passed in an amended form, which limits the powers of the Corporation to the making of a scientific experiment in lighting, but does not allow them to compete with the gas company for purposes of profit.

THE Aldersgate and Edgware Road Stations of the Metropolitan Railway have been lit of late by electric light.

FLOWERS BY ELECTRIC LIGHT.—The shade of a flower varies notably, even in daylight, according as it is seen by the golden light of a southern clime, or under the blue sky of the north. They absorb, as is well known, the warm orange rays of the sun. M. Hugo has observed that the electric light modifies the tints of certain flowers. For example, the central tuft red foliage of the *Nidularium* is brightened in shade by the electric light, whereas the red spots on the leaves of *Caladium* are toned to a reddish brown.

THE TELEPHONE.—M. Decharme, from experiments made with vibrating plates of glass and metal, arrives at the conclusion that diaphragms of telephones should be fixed, not round their rims, but at a single central point. When so fastened they are most sensitive to external vibrations.

THE PHONOGRAPH.—M. Delecheneau has succeeded in getting phonograms on zinc and brass cylinders, by a process which he has not yet divulged.

THEORY OF THE MICROPHONE.—In *Wiedmann's Annalen*, VI., 403, Herr Aron discusses the subject, and assuming that the changes of resistance and current strength are indefinitely small in comparison with the total resistance of the circuit, and the strength due to the battery respectively, the author arrives at the following results:—(1) The different wave systems that traverse the circuit are superposable: (2) The change of phase is greater the higher the pitch of the note: (3) The amplitude, *i.e.*, the intensity of current change diminishes as the pitch rises, and the more so as the resistance and the electro-dynamic potential are greater. Large coils, therefore, in the circuit, are a disadvantage, especially if they have iron cores.

ELECTRICITY AND CATARACT.—Dr. W. B. Neftel, a physician of New York, is reported to have cured a case of incipient cataract by repeated applications of electricity to the diseased eye.

LEAKAGE FAULTS IN CABLES.—In the *Philosophical Magazine* for July, there is an interesting mathematical paper on this subject by Mr. Oliver Heavyside.

HIS EXCELLENCY M. COCHERY, the French Minister of Posts and Telegraphs, has arrived in London.

HONOURS TO ELECTRICIANS.—Dr. Werner Siemens has had the gold medal for Industrial Merit conferred upon him by the German Emperor. The Albert gold medal of the Royal Society of Arts, "For distinguished merit in promoting Arts, Manufactures, or Commerce," has been awarded this year to Sir William Thomson, "On account of the signal services rendered to Arts, Manufactures, and Commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

A SILVER medal has also been awarded, by the Society of Arts, to Mr. Conrad Cooke, for his paper on "Edison's New Telephone."

CAPE TELEGRAPHY.—The *Kangaroo* had not begun to lay the first section of the Cape cable, from Durban to Zanzibar, up to June 17. The *Standard* correspondent, writing from Landsman's Drift, June 15, states that the land wire, as laid by Major Hamilton and Lieutenant M'Gregor, and the C. Troop Royal Engineers, will be completed very shortly to Doornberg. The work has been carried out with great zeal and activity; but the company must now, so far as regards the further laying of the telegraphs, remain idle, the War Office, having, with its usual prescience, sent out a well-organised body of officers and men, with plenty of working material, but omitted to send sufficient wire. He also reports that the demand was made by the corps for 100 miles of semi-permanent wire, which, if laid, would have stood the whole campaign. The field wire has now joined the colonial wire at Ouggar's Kraal, through Dundee and Landsman's Drift to Doornberg. These places will be in telegraphic communication, by signals, with a position, chosen by M'Gregor, of the Engineers, near Lord Chelmsford's headquarters. Had the home authorities sent sufficient wire from Europe there would have been direct communication to Chelmsford with all stations throughout the country. The men of the Royal Engineers, working the telegraphs, have had very heavy work, owing to the quantity of Government and Press work telegraphed.

THE FRENCH ATLANTIC CABLE.—Some 345 knots of the Brest to Nova Scotia section of this cable have been successfully laid by the *Faraday*, which has returned to Brest after buoying the sealed end at Scilly.

ELECTRIC CONDUCTIVITY IN TOURMALINE CRYSTALS.—Prof. Sylvanus Thompson and Dr. O. J. Lodge have been experimenting to determine whether pyro-electric crystals possess unilateral conductivity for electricity, with a view to test the hypothesis of Sir. W. Thomson that the internal polarisation of the crystal is a sufficient cause of the phenomenon of pyro-electricity. Unilateral conductivity is defined as follows:—Let a certain direction from a point A to a point B in a homogeneous substance be considered. Then if it is found that the resistance to the passage of electricity (or heat) is greater or less when the flow is in the direction A B, than it is when in the direction B A, such a substance possesses a unilateral conductivity for electricity (or heat, as the case may be) in the given

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direction. Dr. Thompson finds that the ratio of the two conductivities in opposite directions through a tourmaline crystal when it is becoming hotter is roughly as 100 to 119. The more rapid flow is toward that pole which when the crystal is warmed becomes positively electrical. The faces A B, of the crystal-slice experimented upon corresponded to the antilogous and analogous poles of the original crystal. Dr. O. J. Lodge found a similar effect, and that with a fall of temperature there was a difference of conductivity in the other direction, while with a constant temperature, no difference could be perceived. It therefore appears that in a pyro-electric crystal whose temperature is rising, heat flows more easily *with* the electricity (i.e., from the antilogous to the analogous pole) than it does against the electricity. This "convection of heat by electricity," says Dr. Lodge, "has an apparent analogy with the effect predicted and verified by Sir William Thomson in unequally heated metals (Bakerian Lecture 1856), and which might equally well be called the *convection of electricity by heat:* and it must have an interesting bearing on the theory of Prof. Kohlrausch concerning, 'Thermo-Electricity and Heat Conduction,' set forth in *Poggendorf's Annalen*, vol. 156, p. 601."

CLEANING ELECTRODES.—MM. Beilstein and Sawein, of St. Petersburgh, have found that metal electrodes are kept clean by being well rubbed with oleonaptha, a lubricating oil prepared from Caucasian petroleum, and sold by Ragosin, in Nischny Novgorod. The residual oil opposes very little resistance to the current.

NITRIC ACID IN BATTERIES.—Mr. J. H. Knight states in a letter to *Nature*, that a mixture of half nitric and half dilute sulphuric acid is preferable to nitric acid alone in Bunsen and Grove batteries, since it gives off less fumes and by decreasing the internal resistance increases the current, at least to begin with.

GREASED ZINC IN BATTERIES.—M. Bandechon, writing in *L'Électricite*, states that he has found a sulphate of copper battery with the zinc cylinder slightly greased on the outside surface next the vessel, and a mixture of vinegar and salt for the solution, to give a stronger current than the ordinary Daniell.

BREAKING-IN HORSES BY ELECTRICITY.—The Omnibus Company of Paris have for many years employed a feeble induction current passed through the mouths of vicious horses as a means of taming them. In the Swedish section of the Paris Exhibition there was shown an apparatus for this purpose consisting of a small battery and induction coil, contained in a box about 4 inches long, and having leading wires to pass along the reins. The effect of the current is to produce a kind of paralysis in the animal all at once.

THE MARIE-DAVY AND CALLAUD BATTERIES.—M. E. Caïl has, from numerous comparative experiments, been led to advise the French Telegraph Administration to suppress the small Callaud element, the larger being, however, retained because of its powerful current and capacity for chemicals. A battery of 650 Callaud elements has been replaced at Lille by 1,440 other elements. The Marie-Davy is recommended by M. Caïl when the mercury in it is of good quality; but the Leclanché is preferred to it, and has a distinct place marked out for it in offices of the second class.

TELEGRAPH POSTS IN COCHIN-CHINA.—For temporary lines bamboo is sometimes employed, but they cannot withstand the long-continued action of the dry and wet alternations of climate in these regions. The best posts are made of "tram" (white and red), a wood which is remarkably durable in water and moist earth. It is a kind of eucalyptus, but instead of being a febrifuge it is said to cause fever when growing in masses, and is known as fever-wood. The "viap" is excellent for poles set in damp places; the "sao," the "lau tau," which endures for over fifty years in dry soil, and the "sheu." These last three furnish posts from thirty to sixty feet long.

MACHINE FOR TESTING TELEGRAPHIC POLES.—The French Commission appointed in 1875 to study the question of employing iron poles on telegraph lines, have designed a new machine for measuring the bending stress on these poles when in an erect condition. It has been constructed by M. Thomasset, Paris, and consists of an erect iron frame for stressing the upright pole by means of a horizontal rope, and a mercury manometer for measuring the stress.

ROTARY MAGNETIC POWER OF GASES.—M. Henri Becquerel finds that lighting gas, sulphide of carbon vapour, oxygen, and other gases shift the plane of polarisation of light under a powerful magnetic influence. Oxygen behaves like a highly magnetic body, and gives a negative rotation. M. Bichat also finds that the vapour of sulphide of carbon gives a decided result of this kid.

A "South Jersey Telegraph Company" is also being organised at Camden, N. I. United States.

THE TELEGRAPH IN ARIZONA.—The railroad wire (leased by the Western Union) has been extended eastward through Arizona. It has now reached beyond the Gila river, 82 miles east of Fort Yuma, which latter is said to be the hottest spot on earth, to the place known as Maricopa Wells in the centre of Arizona, and construction has been suspended during the hot season, until cooler weather in the fall. Within a twelvemonth or so, it is anticipated that the overland and all-rail trip can be made by this southern route.

VARLEY'S ELECTRIC HARMONIUM.—This consists of a gamut of tuning forks arranged as spring contact-breakers. A key-board is attached, and the depression of any key directs the current through an electro-magnet, under the influence of which the fork applied to it vibrates, and the corresponding fork is thereupon set into similar vibration. The feeble tones of the fork were much increased when a telephone was placed in circuit, and was still further increased when the telephone was replaced by a piece of apparatus acting like a Leyden jar, and consisting of a sheet of thin gutta-percha, with perforated zinc on one side, and thin tin-foil on the other.—*Proceedings of Newcastle Chemical Society.*

ELECTRO-BRONZED IRON.—A process for covering iron with a durable coating of bronze by electrolysis has been patented by the Philadelphia Smelting Company. The articles to be bronzed are first put into a bath of paraffin, which stops further oxidation. They are then coated with a metallic matter and immersed in the electro-bronzing bath. When taken out they are treated with a protecting varnish before being ready for use. The "deoxidised bronze" employed is an alloy of copper and tin, highly malleable, and capable of a smooth finish.

THE THERMAL AND GALVANOMETRIC LAWS OF THE ELECTRIC SPARK IN GASES.—To study this subject M.

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Villari has constructed a glass globe thickly coated with shellac, and furnished with four tubes, two vertical and two horizontal. These last are traversed by two brass electrodes, interiorly terminated by short wires of platinum or silver, with knobs of silver or platinum, and exteriorly terminated by brass balls. To the upper tubes is fitted a cock which allows different gases to be introduced. To the lower tube is fitted a long glass tube, of about 3 mm. diameter externally. This last tube is maintained vertical and plunged at its lower extremity in a glass which holds a mixture of glycerine and water. The apparatus is enclosed in an insulating box. This novel thermometer was placed in the circuit of a battery of eighteen Leyden jars. In the same circuit is placed also an electrometer jar, and a hand key. The battery was charged by the aid of a Holtz machine; the discharge produced a spark in the globe, and the heat resulting from it depressed the level of the glycerine in the vertical tube. With this apparatus (the electrometer serving to measure the quantity of electricity furnished by the battery), M. Villari finds that for nitrogen, oxygen, hydrogen, and carbonic acid (1) the heat developed in the gas by an electric spark is directly proportional to the quantity of electricity which produces the spark. With a galvanometer in circuit, M. Villari also found that (2) the deflections produced by the discharges of the jar were proportional to the quantities of condensed electricity. Further (3) the deflections produced by the discharge of condenser are constant and independent of the length of the spark produced in any part of the circuit; (4) the quantity of heat developed in a gas by the electric spark increases in proportion to its length, a result which implies that the temperature of the spark at its different points is independent of its length, and that the electric resistance of the gas is proportional to the thickness of the gaseous bed traversed by the discharge. (5) When the charge which produces the spark remains the same the quantity of heat developed by that spark is independent of the surface of the condenser. (6) The galvanometric deflections produced by the discharge of a condenser is independent of its surface. To sum up, the thermal and galvanometric deflections produced by spark or by discharge of condenser, are proportional to the quantity of electricity which produces them, and at the same time to the length of their active circuits, that is, the length of the spark or the length of the galvanometer wire.

Review.

Fragments of Science: a series of detached Essays, Addresses, and Reviews, by JOHN TYNDALL, F.R.S. 6th Edition. Longmans & Co., London.

FOR clear cut thought, lucid style, and felicitous words Prof. Tyndall is admittedly the best of our scientific writers; and in these two handsome volumes he has embodied all his shorter masterpieces. Here will be found his famous Belfast Address which shocked, and reasonably shocked, so many theologians at the time it was delivered, and called forth an avalanche of criticism on the daring climber who had scaled the Alpine heights of Materialism and brought back tables of stone, inscribed with nothing, to his generation. And here too, will be found his replies to that criticism, together with papers descriptive of trips to Algeria, Niagara, and other well-known places often described by artists but seldom by a man of science. The author's speculations on vitality, the nature of man, the efficacy of prayer, are profoundly interesting, but with all the incisive logic and trenchant phrase which Prof. Tyndall brings to bear upon them, the reader has still a comfortable feeling, that there is something in prayer and vitality which eludes the critic s mechanical analogy and the vivisector's knife. Modern Materialism could hardly find a more eloquent exponent than Dr. Tyndall; but, after all, the soul is a thing which defies the prying of a physicist, and the tests of a laboratory. The recent Royal Institution lecture on the electric light concludes the book.

New Patents—1879.

2238. "Improvements in apparatus for transmitting and receiving signals, orders, or messages, for use on board steam and sailing ships and in mines, buildings, and other places." J. S. STARNES. Dated June 6.

2301. "Apparatus for electric lighting." R. WERDERMANN. Dated June 10.

2321. "Apparatus for the production and regulation of electricity applied for illumination." J. D. F. ANDREWS. Dated June 11.

2322. "Electric lamps." C. D. ABEL (communicated by H. Sedlaczek and F. Wikneill). Dated June 11.

2339. "Improved means of obtaining light by electricity." A. M. CLARK (communicated by A. de Méritens & Co.). Dated June 12.

2340. "Electrodes used in the production of the electric light." A. M. CLARK (communicated by C. J. P. Desnos). Dated June 12.

2397. "Improvements in joining telegraph and fencing wires and other wires and strips of metal, and in joining wires to rings or hooks for hanging pictures and for other like purposes." J. SHELDON. Dated June 17.

2402. "Improvements in electric lights and in apparatus for developing electric currents and regulating the action of the same." T. A. EDISON. Dated June 17.

2481. "Apparatus for the transmission of power by electricity." J. HOPKINSON. Dated June 21.

2497. "Transmitters for telephones." A. MARR. Dated June 21.

2543. "Improvements in the manufacture of carbon candles or points, and of carbon plates for electric lighting and other purposes." F. J. DE HAMEL. Dated June 25.

2554. "Improved means and apparatus for producing motive power chiefly for the rotation of magneto-machines used for lighting purposes." J. B. ROGERS. Dated June 25.

2575. "Telegraphic apparatus for railways." E TYER. Dated June 26.

2600. "Receiving apparatus for telephonic communication." F. A. ORMISTON (communicated by H. M. McIntire). Dated June 27.

2629. "An improved submarine telegraphic cable.' A. BLONDOT, J. BOURDON. Dated June 30.

2652. "Electric lamps." C. W. SIEMENS (communicated by F. Von Hefner Alteneck). Dated July 1.

2654. "Telegraphic apparatus." E. C. WARBURTON, L. J. CROSSLEY. Dated July 1.

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2656. "Means and apparatus for immersing submarine telegraphic cables." A. BLONDOT, J. BOURDON. Dated July 1.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.—1878.

3676. "Magnets and armatures for producing motive power." H. E. NEWTON. Dated Sept. 17. 6d. A disc of metal or other material carrying a number of armatures is made to revolve either in a horizontal or vertical direction. A number of magnets equal to the number of armatures are arranged round it and each is attracted in succession by the permanent magnets. Each of the latter is temporarily neutralised after performing its attractive duty.

3707. "Galvanic batteries." C. E. BASEVI. Dated Sept. 19. 2d. This describes a zinc-carbon element in a corked vessel which prevents escape of free hydrogen. *(Not proceeded with.)*

3713. "Galvanic batteries." J. D. ADAMS (communicated by Alfred Niaudet, Paris). Dated Sept. 19. 6d. In this battery chloride of lime is the depolarizing salt. The zinc pole is plunged in a solution of common salt and water: the carbon pole is surrounded with chloride of lime in a porous jar; the battery is enclosed in a hermetically sealed box.

3744. "Telegraphing on board ship." E. A. CAMINADA. Dated Sept. 21. 6d. This describes a plan for telegraphing the position of the rudder or other information on board ship by means of electricity.

3892. "Telephones." J. H. JOHNSON (communicated by F. A. Gower and C. Roosevelt, Paris). Dated Oct. 3. 6d. This describes Gower's well-known telephone call by means of a reed in the diaphragm. *See* TELEGRAPHIC JOURNAL, March 1.

3916. "Microphonic speaking apparatus." C. F. VAREY. Dated Oct. 4. 2d. The apparatus consists of a carbon pencil microphone enclosed in a case. The air inside the case is set in vibration by the voice by means of a diaphragm in one side of the case.

3923. "Construction of electro-magnetic letter indicating and type printing telegraph instruments." W. E. IRISH. Dated Oct. 5. 6d. The object of this invention is to render type printers self-acting, requiring no train of clockwork, all the work being done by a simple electrical make and break action.

3924. "Electrical apparatus for telegraphic and similar purposes." S. F. V. CHOATE, New York. Dated Oct. 5. 8d. This describes a plan for facilitating working on submarine cables by means of repeaters sunk in hermetically sealed globes at a point on the cable between the sending and receiving stations.

3930. "Telephonic apparatus for domestic and other uses." J. H. MCLURE. Dated Oct. 5. 6d. This describes an indicator for central telephone stations common to all the circuits.

3960. "Telegraphic transmitting, receiving, and call apparatus." J. F. BAILLEY. Dated Oct. 8. 6d. This apparatus works without a battery by the induction produced by rapid separation of an armature from the poles of a magnet. It is both receiver and transmitter and contains two armatures, one of which is moved by the operator in order to produce a signal in the line, the other under the influence of currents in the line strikes out signals.

3971. "Connecting the ends of wire for continuous fencing, electric telegraphs, &c." G. and E. WOODS. Dated Oct. 9. 6d. This consists in a mode of jointing wires by nipping the two ends between metal surfaces of a connecting piece.

3976. "Magneto-electric machines." M. R. WONDE. Dated Oct. 9. 6d. This consists in forming the armatures of magneto-machines in such a way that the pole pieces of the magnets and the core of the armature are close together. This is done by nicking out the core of the armature and winding the coils in the niches.

3988. "Electric lighting, &c." ST. G. L. FOX. Dated Oct. 9. 6d. This consists in making an incandescent lamp from a strip of platinum or platinum-iridium alloy. On each side of this strip is placed a sheet of mica or talc to prevent cooling of the strip by the atmosphere. A spiral coil of foil with a tube of talc, kaolin, glass, steatite, or lime, within the spiral, and with a tube of talc, glass, &c., just covering it outside is also used. By increasing the width or number of strips more volume of light is obtained, by shortening them, more intensity. Planté secondary batteries may be used at the main and the earth.

4006. "Electric lighting apparatus." P. DENSEN (communicated by Siegfried Marcus, Vienna). Dated Oct. 10. 6d. This describes an incandescent carbon lamp similar to Reynier's and Werdermann's. A vertical carbon pencil rubs upon a rotating cylinder of carbon, and the current passing from the pencil to the cylinder causing the point of the former to glow. The pencil is pressed forward as it consumes by a weight and pulley.

4007. "Electric clocks." R. H. BRANDON (communicated by C. W. Firnhaber, Paris). Dated Oct. 10. 6d. This describes an electro-magnetic arrangement for regulating clocks by a motor clock.

4016. "Electric lighting, heating, and motive power apparatus." JOHN MUNRO. Dated Oct. 11. 4d. This consists of a current divider or distributor for the electric light, capable of feeding a large number of separate lamps, without interference of one light with another. It is based on the principle that if the current supplying a lamp be an intermittent one whose pulsations succeed each other a sufficient number of times per second the effect is the same as if it were a continuous current. A shaft connected to the source of electricity revolves with great rapidity and distributes the current to a series of branch circuits set radially round the shaft, one after another by means of brushes, cams, or helical contacts. This shaft may be driven by clockwork or electricity &c. Besides the rotating shaft, oscillating shafts, levers, and vibrating bodies, such as tuning-forks, may be used to distribute the current. The divider may be placed beside the generator, or at a distance from it, in a house, so as to supply a given number of lights. The intermittent currents from the divider are rendered continuous again, or nearly so, by being passed through induction apparatus and secondary batteries. *(Not proceeded with.)*

4022. "Arrangements for electric lighting." J. W. T. CADETT. Dated Oct 11. 4d. This consists of a current regulator in which a carbon resistance dipping into mercury is inserted in the circuit of the lamp. By means of electro-magnetism this carbon is plunged more or less in the mercury according to the strength of the current, thereby interposing more or less resistance in circuit.

4031. "Softening or diffusing electric and other light." A. M. CLARK (communicated by L. Clémandot, Paris). Dated Oct. 11. 6d. This consists in using globes formed of two shells with glass wool between.

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SOUTH AFRICAN TELEGRAPHY.

TELEGRAPHY is making great strides in South Africa. Early in January last the line from Durban to Fort Pearson was opened. In February the grand trunk line from Maritzburg, inland to Pretoria was commenced, and it was completed and opened as far as Utrecht in the Transvaal in the middle of May. The telegraphic communication is now complete from the Zulu border at its two extreme points, the south-east and the north-west to Cape Town. The advantages accruing in a military sense from such a fact are self-evident; they cannot be over estimated. The credit of this most useful work is due to the untiring energy and able organising power of Mr. Sivewright, in whose hands is now vested the general management of South African telegraphs in both the Cape Colony and Natal.

The *Natal Mercury* on this subject says:—Mr. Sivewright may be regarded as the practical harbinger of Confederation, as he has done more to unite the erewhile separated communities of South Africa, and to identify their interests and concerns, than any living man. Most effectively aided by his indefatigable constructor, Captain Fraser, he has brought the Cape and Natal, the Diamond Fields and the Cape, Natal and the Transvaal, Zululand and Natal, within speaking range of each other. He has done this in spite of apathy, sloth, and division amongst ourselves, and he deserves all the credit and thanks that we can accord him for valuable services zealously and successfully rendered.

Proceedings of Societies.

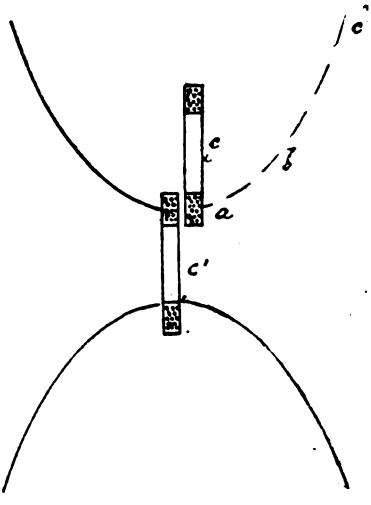
PHYSICAL SOCIETY.—JUNE 28TH, 1879.

Prof. W. G. ADAMS in the Chair.

PROF. W. G. ADAMS described his New Measuring Polariscope. The polariscope consists of three principal parts. The lowest section consists of a mirror, a lens, a Nicol's prism, and two other lenses. The upper section consists of similar lenses and Nicol's prism arranged in the reverse order. Each lens and Nicol's prism is supported separately by screws, and its position can be altered independently of the others. These two parts form a complete polariscope. Besides these, there is a middle piece, consisting of two lenses (nearly hemispheres) forming a box to enclose the crystal immersed in oil, their curved surfaces being concentric. The whole middle piece is supported on the tubes of the upper and lower portions, and may be turned about the optical axis of the instrument. The vertical graduated circle carrying the central lenses and crystal may be turned through any angle about its horizontal axis. By means of an arc fastened perpendicularly on the graduated circle with its centre at the centre of curvature of the central lenses, the crystal may be turned about another horizontal axis at right angles to the former, so that the crystal and central lenses can be turned about each of three axes which are mutually at right angles. By means of a system of toothed wheels in gear with the rim of the central lenses the crystal and central lenses may be turned separately about the optical axis of the instrument, so as to bring the plane of the optic axes of a biaxial crystal parallel to the plane of the vertical graduated circle.

Sir John CONROY, Bt., read a paper on "The Distribution of Heat in the Spectrum." After referring to Dr. T. W. Draper's supposition that all the rays in the spectrum have the same heating effect, and to his statement that owing to the unequal dispersion of the prism for rays of different refrangibility, the method that has been used for determining the calorific intensity of the various parts of the spectrum, is an essentially defective one. He described a graphical method for eliminating the effects of the unequal dispersion of the prisms, and showed, from MM. Fizeau and Foucault's measurements, and also from those of Jamansky and Professor Tyndall, that the maximum intensity is about the middle of the spectrum and not at the red end; and further, that the curves given by various observers as representing the intensity of the heat in different portions of the spectrum are in reality the "Dispersion Curves" for the particular prisms employed.

Mr. GRANT then described an investigation which he had made into the induction lines round two parallel coils of wire; in the primary coil an intermittent current of electricity from a Leclanché battery flowed, and in the secondary a telephone was connected up to detect the induction sounds. With this apparatus he found that with the coils kept parallel to each other, there were lines, or rather a surface of minimum induction surrounding the primary, and that if the secondary were placed in these lines hardly any induction noise could be detected. A diagram representing a medial section through the coils showed the lines to proceed from the wire of the coils in two curves resembling parabolas, one from each cross-section of the wire outwards, as shewn in the figure.



Dr. SHETTLE then described his experiments proving the lines of force in a bar magnet to run spirally round the bar between the equator and poles: the equator being decentred and oblique across the bar as shown by diagrams.

Prof. ROWLAND of Baltimore made some observations on the new theory of terrestrial magnetism of Profs. Ayrton and Perry. He said the experiments on which the theory was founded had been attributed to Helmholtz, but they were entirely his own, he having gone to Berlin to make them. The new theory had occurred to himself. On making these experiments out he had rejected it because he found that the potential which the earth's surface would require to have would not only cause violent planetary disturbances, but by mutual repulsion drive objects off the earth. He had made also an experiment to see if absolute motion of electricity would cause magnetisation, but failed to get any effect

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from it. Then he resorted to calculation to find the magnetic effect of relative motion by rotation of a charged sphere of perfect magnetic permeability that is more magnetic than iron. He found that when the sphere was uniformly charged and rotating there would be a magnetic field in its interior; but instead of the result of Messrs. Ayrton and Perry that if the earth were charged to a potential of, he believed, 10^8 volts relatively to interplanetary space, the earth's magnetism would be what it is. He found the necessary charge to be 61×10^{13} volts. In the ordinary atmosphere this potential would produce a spark nine million miles long, and discharge across to the moon. If the moon were electrified to the same degree the mutual repulsion would overcome the force of gravity between them. He therefore considered terrestrial magnetism to be still a mystery.

He had also thought that the aurora borealis might be explained by supposing the upper regions of the earth's atmosphere electrified; the winds carrying the upper strata towards the poles, electricity would condense there. This hypothesis is tenable still.

Prof. AYRTON said that whether or not the new theory of magnetism should be so rejected depended on whether or not, Prof. Rowlands calculations or those of himself and Prof. Perry were wrong. It had been found by Sir William Thomson from experiments at Arran, that the earth was electrified with respect to the earth and that there is a difference of potential of 30 volts between earth and air for each foot of ascent. This gave 1360×10^{12} centimetre-gramme-second electrostatic units as the potential of the earth. The new theory required the potential to be 1011×10^{11} supposing the earth to be of solid iron, or about 14 times more—a wide margin.

Prof. ROWLAND said he had not seen the calculations of Profs. Ayrton and Perry yet, but he believed his results to be correct, as he had checked them.

Mr. BAILLEY exhibited a modification of Avago's experiment, in which a copper disc is caused to rotate continuously by changing the polarity of four electro-magnets underneath by a revolving commutator.

Mr. CONRAD COOKE exhibited a single voltaic element showing the internal current. This is done by forming the glass vessel containing the element into a helical tube between the poles, and hanging a galvanometer needle in the interior of the helix; the internal current deflects the needle.

General Science.

MALLEABLE BRONZE.—A collection of bronze plate as malleable as iron, and a quantity of leaves, wires, tubes, &c., of the same material, was recently exhibited at a *seance* of the French Academy of Sciences. They were produced by a process still kept secret by its inventor, M. Reynier.

MALLEABLE BRASS is made by alloying 33 parts of copper and 25 of zinc, the copper being loosely covered with the zinc in the crucible. As soon as the copper is melted, zinc purified by sulphur is added. The alloy is then cast into moulding sand in the shape of bars, which are malleable into any form when still hot.

COATING COPPER WITH IRON.—Professor Bœttger recommends the following solution for coating copper plates with iron. Ten parts of ferro-cyanide of potassium and twenty parts of cartrate of soda are dissolved in 220 parts of distilled water, adding a solution of three parts sulphate of iron in fifty parts of water. Caustic soda solution is then poured into the mixture until the Prussian blue formed is re-dissolved.

M. TOSELLI is the inventor of the bi-automatic grapnel, which, by means of water pressure, either opens out or spurts its flukes round the body it is intended to lay hold of. At Ajaccio recently, a sack of merchandise, weighing 50 kilograms, and at the port of Nantes, a quantity of coal were raised in a few minutes by this grapnel. A closed electric lamp, with a reflector to direct the beam downwards on the flukes, is also fitted over this grapnel to illuminate the bottom in shallow waters.

City Notes.

Old Broad Street, July 12th, 1879.

EASTERN TELEGRAPH COMPANY.—In anticipation of the meeting, the half-yearly report of this Company has been circulated. It shows a balance of £144,342, from which £14,480 has been paid in interest on debentures, and £20,560 is required for dividend to the 31st March last at the rate of 6 per cent. per annum on the preference shares. An *interim* quarterly dividend of 1½ per cent. has already been paid on the ordinary shares, and it is now proposed to declare a final dividend for the year ended March last of 2s. 6d., making, with three previous payments on account, a total dividend of 5 per cent. for the twelve months. The sum of £16,876 is to be added to the reserve fund, raising it to £175,512. The Telegraph Construction and Maintenance Company have engaged to manufacture and lay the cables between Aden and Natal, and provide a suitable maintenance ship at a cost of £950,000. The work is to be completed by December next. As the directors consider it inexpedient that the Eastern Company should take the entire responsibility of the undertaking, it is proposed to form a separate concern, to be called the Eastern and South African Telegraph Company, with a share capital of £400,000 and mortgage debentures for £600,000.

THE EASTERN EXTENSION COMPANY have declared an *interim* dividend, for the quarter ending March 31st last, of 2s. 6d. per share, or at the rate of 5 per cent. per annum, free of income-tax.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—The directors have declared an interim dividend of 12s. per share, or at the same rate as for the corresponding period last year.

The following are the final quotations of telegraphs for the 12th inst.:—Anglo-American, Limited, 54½-55; Ditto, Preferred, 84⅜-85¼; Ditto, Deferred, 26½-27; Brazilian Submarine, Limited, 6⅞-7; Cuba, Limited, 8-8⅛; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 10⅜-11¼; Direct United States Cable, Limited, 1877, 10⅜-10⅝; Eastern, Limited, 7⅛-7⅛; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 103-105; Eastern, 6 per cent. Preference, 11⅜-12; Eastern Extension, Australasian and China Limited, 7⅛-7⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; German Union Telegraph and Trust, 7⅜-8¼; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10⅜-11; Great Northern, 8¼-8⅜; Indo-European, Limited, 20⅜-21¼; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 9-10; Submarine, 225-235; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference 7⅛-8⅛; Ditto, ditto, Second Preference, 7⅛-7⅛; Western and Brazilian, Limited, 3-3½; Ditto, 6 per cent. Debentures "A," 96-100, Ditto, ditto, ditto, "B," 88-93; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 118-122; Ditto, 6 per cent. Sterling Bonds, 106-108; Telegraph Construction and Maintenance, Limited, 30⅜-31¼; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2⅛-2⅜; India Rubber Co., 12¼-12¾; Ditto, 6 per cent. Debenture, 105-108.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 156.

THE ELECTRIC LIGHT ON THE EMBANKMENT.

THE decision of the Metropolitan Board of Works to continue the use of the electric light on the Embankment for a period of six months longer, and to extend the Jablochkoff lamps over the Waterloo Bridge and up Northumberland Avenue to Trafalgar Square, is one of the most hopeful signs for the future of this means of illumination which have yet appeared. It speaks a vast deal more for the success of lighting by electricity than any sanguine criticism whatever, or even than those judicious telegrams which Mr. Edison chucks to a hungry and dissatisfied public, as a morsel of sweet sop to Cerberus. There has been a reaction against the electric light of late, and even scientific journals, which ought to have known better, have admitted into their pages articles treating of its utter "collapse." The best proof that there is no collapse of the electric light, is to be found in the steady, if slow, advance it is everywhere making. It is recognised now that great wonders are not to be accomplished all at once in electric lighting, even by the inventive wizard of Menlo Park; but, at the same time, it is put beyond a doubt, that this mode of illumination has securely established a footing, and is destined to develop by dint of continued improvement. The gratifying resolution of the Board of Works which we have recorded, is mainly due to a noteworthy progress which has been effected in the Jablochkoff mode of lighting employed on the Embankment. In the first place, frosted globes have been substituted for the opaline globes formerly used, and the practical result of this is to raise the luminous power of each lamp from 155 candles to 265, a gain, that is, of 70 per cent. The increased beauty and efficiency of the lamps is very remarkable. In the second place, it has been demonstrated that the high-pressure engine of 20 horse-power nominal employed is really capable of sustaining as many as 60 Jablochkoff candles ablaze. At present only 40 are utilised; but M. Berly, the engineer who has charge of the works of the Societé Général de l'Electricité, has recently set up 20 additional candles in the machinery shed at Charing Cross, and with these it is proposed to illuminate Waterloo Bridge on the one hand and Northumberland Avenue on the other. When this has been done, M. Goudet, the managing director of the French company in England, has undertaken to maintain the 60 lights at 3d. per hour per lamp, the Board bearing the cost of installing the extra lamps and providing the two new Gramme dynamo-electric machines required for the latter.

In comparing this new scale of charge with the cost of gas, it turns out that, reckoning a 16-candle gas-jet at 3s. 6d. per 1,000 cubic feet, 3d. an hour, would only give us a gas-light equivalent to 230 candles; but the photometric power of each Jablochkoff candle, under the new frosted globes, is 265 candles, as determined by Mr. Keates, consulting chemist to the Board: therefore, the Jablochkoff light may now be said to have the advantage of gas, light for light. Further, the more electric lights there are required, the cheaper can they be supplied, as a limited experiment is more costly than a general introduction on a large scale would be. The importance of this achievement can hardly be exaggerated, when we consider the adverse reports which have been hitherto published, on the Jablochkoff mode of lighting on the Holborn Viaduct and at Westgate-on-Sea. It is a great matter to have reduced the expense of electric street-lighting to at least the same as that of gas; and, if electricians can only better this by making it practically cheaper than gas, they will reap a rich reward, for it is only the purse which argues in favour of gas-lighting.

OBACH'S PATENT TANGENT GALVANOMETER.

THIS galvanometer, which is manufactured by Messrs. Siemens Bros., is designed principally for the accurate measurement of the very powerful currents given by dynamo and magneto-electric machines, such as used for the electric light, for plating and depositing purposes, &c. In general appearance this instrument resembles an ordinary tangent galvanometer, but, unlike the latter, the ring through which the current passes is movable around its horizontal diameter lying in the meridian; the inclination of the ring to the horizontal plane is read off on a vertical scale. With a constant current strength, the force with which the magnetic needle in the centre of the ring is deflected from the meridian is proportional to the *sine* of the angle, which the plane of the ring encloses with the horizontal plane. Instead of measuring the angle between the ring and the horizontal plane, the angle which the ring makes with the vertical plane could also be taken, but in this case the *cosine* of the observed angle would be employed in place of the sine. In the instrument described the angle of the ring with the horizontal plane is read off, as the natural values of the sine are more frequently given in tables than those of the cosine, and can be used without further trouble.

Fig. 1 is a perspective view of the apparatus, showing the ring in an inclined position. From a base G, provided with three levelling screws, rises a stout brass column S; the bottom of this column is formed of a square block cut out at one side in the

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shape of a ⊃, and made strong enough to insure it against bending. The column can be turned on its axis in order to place the instrument in the magnetic meridian; the screw S′ holds it firmly in its place. On the top of the column is a circular brass box N, about 8″ in diameter and 1⅜″ high. each side of the opening, a semi-circular piece of gun-metal with clamp screws K′ K is fixed. On the inner face of the ring the opening is bridged over by a strong piece of ebonite H, in which a brass bush is inserted to hold the pivot on the end of the arm P′. The pivot on the arm P projects somewhat

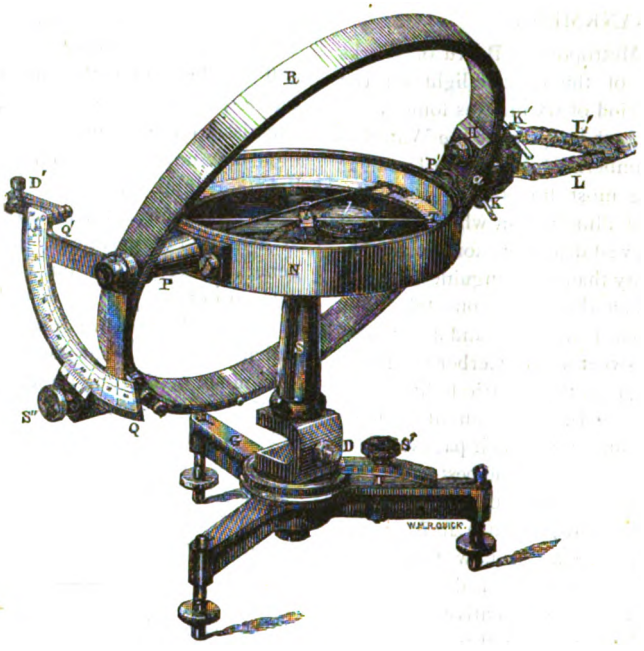

FIG. 1.

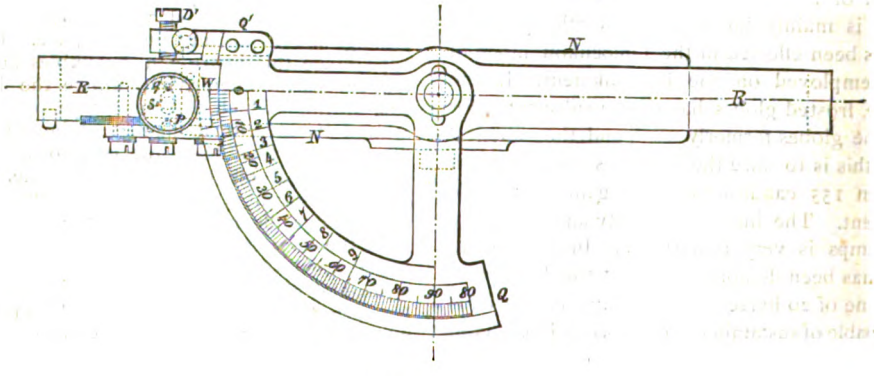

FIG. 2.

Conical arms P P′ are screwed to opposite sides of the box, and serve to support the ring R. This ring is made of gun-metal containing a high per centage of copper; the dimensions are 11¾″ inner diameter, about ⅜″ thick, and 1″ broad, so that the ring offers an exceedingly small resistance to the current. At *a* the ring is cut through; on the outer face, and at beyond the ring R, and is insulated from it by an ebonite collar, over which is placed a brass collar for the ring to turn on, On this projecting pivot the quadrant Q′ Q, fig. 2, is placed, and held firmly by a pin. This quadrant is divided into degrees, and the angles, the sines of which (for radius = 1) correspond to the values 0·1, 0·2, 0·3 . . . 1·0, are

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shewn on the same scale by longer marks. Fixed to the ring R, and insulated therefrom, is a brass arm carrying at its end a vernier W, which moves over the quadrant Q. The screw S'' clamps both vernier and ring; the latter at its extreme vertical position is arrested by a screw D (fig. 1) in the lower part of the column and by another screw D' (figs. 1 and 2) when in the horizontal position. On loosening the screws *q* and *p* (fig. 2) the vernier can be shifted a little, so that when the zero adjustment of the ring is first made, the required agreement between the divisions on the vernier and quadrant can be obtained. This adjustment is made by sending as strong a current as possible in alternate directions through the ring, and then bringing the latter, by the alteration of the screw D', into such a position that no deflection of the needle takes place. When this is the case the vernier is set to zero. Within the circular box N (fig. 1), and at about half its height, is the circle T, divided into degrees of sufficient size to enable a tenth to be easily read. The length of the magnet is only $\frac{1}{15}$ the diameter of the ring; it carries an aluminium pointer, and is fixed to an axis, which is worked to a fine point at each end. On the circle T, in an exact line through the bearings of the ring, is screwed a light brass frame, having an agate bearing in the centre, and beneath it, in the middle of the box, is a second jewel or agate bearing. In these bearings the axis of the magnet plays. A screw underneath the brass box, acting on a brass spring, stops the movement of the needle. A small spirit level *l* is fixed in the box, so that the galvanometer may be accurately levelled. The current to be measured is led to the ring by means of two thick insulated copper wires L L' (fig. 1), which are wound together for a distance of about three feet, and connected to the clamp screws K K'.

Measurements with the galvanometer may be made in several ways: thus, by keeping the ring fixed, the tangents of the deflections represent the relative strengths of the currents producing those deflections, and this will be the case whether the plane of the ring be vertical or at an angle.

If the angle at which the ring is set be varied so as to produce the *same* deflection with currents of various strengths, then the relative values of the latter will be in the proportion of the *cosecants* of the angles at which the ring is set.

It may also be remarked that if different currents are measured with the ring at different inclinations, then the relative strengths of those currents will be proportional to the tangents of the deflections divided by the sines of the corresponding inclinations of the ring.

These theoretical results are completely verified by experiment.

To give an idea of the wide range of the instrument, it may be mentioned that it was possible to measure, without using any shunt, the powerful current developed by six dynamo-electric machines with their inductors connected up parallel, the whole of the electro-magnets being excited by a seventh machine. The resistance in the circuit was very small, being about the same as that of the parallel inductors.

When the ring of the galvanometer stands in the vertical position a current of 1 Weber deflects the needle about 13° at Woolwich.

ON HIGH ELECTRICAL RESISTANCES.

By J. HOPKINSON, F.R.S., D.Sc.

IN the *Philosophical Magazine* of July, 1870, Mr. Phillips describes a method of readily constructing very high electrical resistances. A pencil-line is ruled on glass; the ends of the line are provided with the means of making electrical connexion; and the whole is varnished: by this means a resistance of two million ohms was obtained; and it was found to be constant under varying potential. This method of constructing resistances is alluded to in Maxwell's "Electricity" (p. 392); but I do not know that it has received the examination it deserves, or that it has come into general use. Having need of resistances of over 100 million ohms, I have made a few on Mr. Phillips's plan, ranging from 26,000 ohms to 96,000,000 ohms (which are fairly satisfactory), and one or two much greater (which do not conduct according to Ohm's law, but with a resistance diminishing as the electromotive force increases). A short description of these may perhaps save a little trouble to others who desire tolerably constant high resistances.

All my resistances are ruled on strips of patent plate glass which has been finished with fine emery, but has not been polished. The strips are twelve inches long, and, except in the cases specified belows about half an inch wide. One or more parallel linen are ruled on each strip, terminating at either end is a small area covered with graphite from the pencil. The strip of glass, first heated over a spirit-lamp, is varnished with shellac varnish, excepting only these small terminal areas, which are surrounded by a small cup of paraffin-wax to contain mercury to make the necessary connexions. To secure better insulation, feet of paraffin or of glass covered with paraffin are attached on the underside at the ends of the strip to support it from the table. Before varnishing, each strip was marked with a distinguishing letter. The strips marked *g*, *h*, *i*, *a* and *b* were ruled with a BB pencil, the remainder with a HHH.

These resistances appear to be not quite constant, but to vary slightly with time, the maximum variation in four months being slightly in excess of $\frac{1}{2}$ per cent. In every case they were examined under varying potential to ascertain if they obeyed Ohm's law. With the exception of *f*, described below, all were satisfactory in this respect. The resistance appears to diminish slightly as the temperature rises; but this conclusion rests on a single rough experiment, and must be regarded as uncertain.

The values of the resistances were determined with a differential galvanometer, each coil having a resistance of 3,500 ohms, by the well-known method of dividing a battery-current, passing one part through the large resistance to be measured and one coil of the galvanometer, the other through a set of coils or other known resistance, and then through the galvanometer shunted with a second set of resistance coils. *g* was thus compared with standard coils. *g* was then used to find *h* and *i*; and $h + i$ was used to find *a* and *b*. A Thomson's quadrant electrometer was used to compare in succession *k*, *l*, and *m* with $a + b$, *c* and *d* were similarly

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compared with $k + l + m$; and, lastly, c and e were used to examine f.

g is ruled on a strip one inch wide, rather more than half the surface being covered with graphite. Three experiments on the same day gave 26,477, 26,461, and 26,470 ohms; the variations are probably due to uncertainty in the temperature correction, the galvanometer-coils being of copper. After the lapse of four months 26,615 ohms was obtained.

i is ruled on a strip three quarters of an inch wide, with nine tolerably strong lines; its resistance was first found to be 209,907 ohms, and four months later to be 208,840.

h has four strong lines on a strip half an inch wide; resistance 207,954 on a first occasion, and 208,750 after the lapse of four months.

a has two lines narrower than the preceding; resistance 5,240,000 at first, and 5,220,800 after four months.

b has a single line apparently similar to either of those of a; and the resistance is 9,168,000.

k, l, and m have each two lines ruled with a HHH pencil; their resistances are respectively 23,024,000, 14,400,000, and 13,218,000 ohms.

c and e also have two lines, but they are finer; the resistances are 79,407,000 and 96,270,000.

As already mentioned, all the preceding were tested with various battery-power, and were found to obey Ohm's law within the limits of observation. It was not so with f, as the following observation shows very clearly. c, k, e, and f were arranged as a Wheatstone's bridge. Junctions (f, c and e, k) were connected to the poles of a Daniell's battery varying from one to eighteen elements; junctions (e, f and k, c) were respectively connected through the reversing-key with the quadrants of the electrometer. The potential of one Daniell's element was represented by 270 divisions of the scale of the electrometer. Column I. gives the number of elements employed, II. the corresponding reading of the electrometer, III. the value of $\frac{k}{k+c} - \frac{e}{f+e}$ deduced therefrom, and IV. the values of the ratio resistance of f: resistance of e.

I.	II.	III.	IV.
1	16	0·060	5·1
2	25	0·046	4·6
3	31½	0·039	4·4
4	31	0·029	4·1
5	28	0·021	3·9
6	27½	0·017	3·8
9	10	0·0041	3·5
12	— 5	—0·0016	3·4
15	—25	—0·006	3·3
18	—47	—0·0097	3·25

This result is by no means surprising. There is doubtless an exceedingly minute discontinuity in the fine line across which disruptive discharge occurs; and the moral is, that resistances of this kind should always be tested as regards their behaviour under varying electromotive force.

Several attempts to rule a line on a strip twelve inches long, with a resistance over 100,000,000 ohms, resulted in failure.—*Philosophical Magazine.*

EXAMINATION OF CERTAIN ALLOYS BY AID OF THE INDUCTION-BALANCE.

By W. CHANDLER ROBERTS, F.R.S., Chemist of the Mint.*

SOME weeks since, Prof. Hughes showed me that equal volumes of various metals give widely different indications with the induction-balance. It appeared probable that a careful examination of a definite series of alloys would prove to be of interest; and as Prof. Hughes at once gave me the most generous assistance, teaching me the manipulation and controlling the results, I am able to submit the following observations to the Society.

The relative values of different metals as indicated by the induction-balance were given by Prof. Hughes in a paper read before the Royal Society on the 15th of May last. They do not accord with the values usually accepted as representing the relative conductivity of the respective metals; and this being the case, it became important to ascertain what relation the indications given by alloys, when under the influence of the induced current, bear to their electric conductivities, which afforded Matthiessen a basis for dividing them into groups.†

A series typical of each group was therefore taken; the constituent metals were melted together in the requisite proportions; and the thoroughly mixed alloys were carefully rolled to a uniform thickness, usually 1·3 millim. Discs 24 millims. in diameter were then cut with the same punch; and these discs were placed in succession on one side of the balance, so that their bases lay exactly on a line midway between the primary and secondary coils, this having been found to be the plane of maximum force. The respective values of the alloys were ascertained either by introducing the sonometer into circuit, or by superposing a graduated wedge-shaped scale of zinc over the opposing coil of the balance, as has already been explained by Professor Hughes.

The alloys of Lead and Tin were selected as an example of Matthiessen's first group. The results are recorded in the following table, and are graphically indicated in the curve No. 1, plate vi. The readings are those of the zinc scale.‡

The Gold-Silver alloys, representing the second group, presented no difficulty of manipulation; and the observations were made on discs 1·3 millim. thick and 24 millims. in diameter. The results are given in the table and in curve No. II.

The alloys of Tin and Copper, taken as representative of the third group, are peculiar. Their tints and fractures are widely different; and the series is interesting as having various industrial applications. As many of them are too brittle to roll, a block of each alloy 18 millims. square by 7 millims. thick was formed with the file. The

* Read before the Physical Society.

† British Association Report, 1863, p. 37.

‡ The use of a scale of greater accuracy than the one employed may slightly alter some of the figures, but it can hardly change the general nature of the curves.

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results are given in the table and on the curve No. III.

	No.	Percentage composition.	Approximate formula.	Readings on Induction-balance.
TIN-LEAD.	1.	100 (pure tin).		67·5
	2.	77·37	Sn_6Pb	62·0
	3.	69·60	Sn_4Pb	59·0
	4.	53·20	Sn_2Pb	52·5
	5.	36·30	$SnPb$	51·0
	6.	23·30	$SnPb_2$	47·0
	7.	12·50	$SnPb_4$	45·0
	8.	8·60	$SnPb_6$	46·0
	9.	0 (pure lead).		43·0
SILVER-GOLD.	1.	100 (pure silver).		225
	2.	99·97		209
	3.	99·90		205
	4.	99·50		192
	5.	99·10		170
	6.	98·02		148
	7.	94·93		115
	8.	90·00		84
	9.	81·40	Ag_6Au	60
	10.	68·70	Ag_4Au	48
	11.	52·30	Ag_2Au	44·5
	12.	35·50	$AgAu$	42·8
	13.	21·50	$AgAu_2$	44
	14.	12·00	$AgAu_4$	49
	15.	8·30	$AgAu_6$	60
	16.	4·1		90
	17.	0 (pure gold).		150
COPPER-TIN.	1.	100 (pure copper).		167
	2.	89·00	$SnCu_{16}$	65
	3.	84·33	$SnCu_{10}$	51
	4.	79·02	$SnCu_7$	45
	5.	72·91	$SnCu_5$	40
	6.	68·28	$SnCu_4$	37
	7.	65·00		49
	8.	61·79	$SnCu_3$	83
	9.	51·84	$SnCu_2$	73
	10.	34·99	$SnCu$	73
	11.	9·73	Sn_6Cu	82
	12.	0 (pure tin).		85

Note.—The Alloys were not annealed; and the temperature was about 15° C.

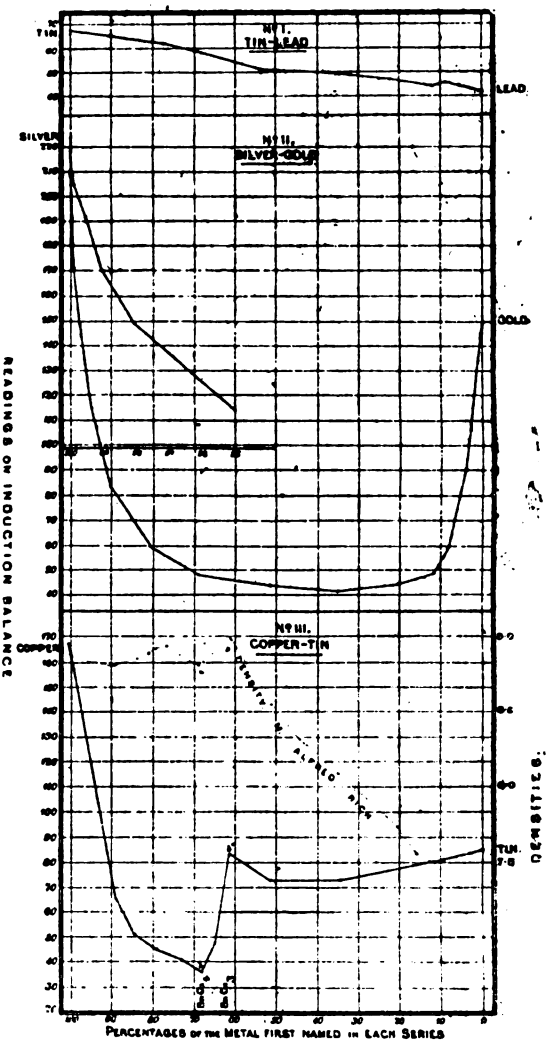
If the curves for lead-tin and gold-silver are compared with those given by Matthiessen* for the same alloys, their similarity will at once be evident. On the other hand, the induction-balance curve of the tin-copper series, while bearing some general resemblance to Matthiessen's curve of conductivity, differs essentially from it in certain parts. Matthiessen's curve falls rapidly from 93 (the conductivity of pure copper) to 9 (that of the alloy containing *volumes* per cent. of copper). It then passes horizontally in a line which is approximately straight to 13, the conductivity of tin.

Some light would appear to be thrown on the difference between the two curves by the work of M. Alfred Rich† on the density of alloys of copper and tin. He showed that copper and tin contract in alloying, the contraction being regular from pure tin up to the alloy containing 38 per cent. of tin, the density of which is higher than that of pure copper.

* *Op. cit.* p. 46, and Watts's Dictionary of Chemistry, vol. iii. p. 943.
† *Ann. de Chimie et de Phys.* tome xxx. 1873.

M. Rich's experiments were conducted on alloys both in the form of powder and ingots; the latter have alone been given in the curve marked with his name on the plate; and the relation between the two curves, especially at the points *a*, *a'*, *b*, *b'*, is too evident to need comment.

It may ultimately prove that if the alloys were rolled or compressed the curve would be modified; and, on the other hand, further experiments on the conductivity of the alloys may reveal points of



identity between the conductivity and induction-balance curves; the part where the former from being vertical becomes horizontal would be especially worth examination. It may be well to point out that the alloys $SnCu_3$ and $SnCu_4$, which occupy critical positions on the induction curve, have been shown by M. Rich to be singularly free from the disturbing influence of liquation.

The work would appear to be interesting, as showing that the induction-balance may afford a simple means for detecting variations in the

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molecular structure of alloys, and for indicating allotropy in metals with greater accuracy than has hitherto been possible.

Practical application.—The possibility of ascertaining the standard fineness of alloys, by the aid of electricity, long ago occupied the attention of physicists. In 1823 M. Becquerel* suggested that trustworthy indications might be afforded by the electromotive force developed when the alloy is placed in an exciting fluid, together with an alloy of known composition. The subject was partially investigated by Œrsted in 1828†; and as its practical importance was further indicated by Gay-Lussac in 1830‡, I made a series of experiments in order to ascertain how far the more delicate appliances in use at the present day could be made available. The results, however, were not entirely satisfactory.

Prof. Hughes's induction-balance rendered it possible to resume the research on a new basis. It is only necessary to glance at such a curve as that of the gold-silver series, No. II., to be satisfied of the probability that certain parts of it, at least, would indicate minute differences of standard. I would, therefore, direct special attention to the series of alloys which lie between pure silver and silver alloyed with 5 per cent. of gold. These are shown in a separate curve, where the scale of percentages is more extended. Such alloys as Nos. 2 to 6 are known to refiners as doré; and No. 2 contains less than two grains of gold to the pound troy, a quantity which could not be extracted with profit by the ordinary operation of "parting." Small as the amount of precious metal is, its presence is clearly indicated on the induction curve, as are also the larger amounts of gold contained in Nos. 3–5.

Experiments are in progress on other series which promise to afford trustworthy indications; but, of course, the establishment of a method of verifying the composition of alloys of the precious metals must, in part, depend on the degree to which the presence of traces of foreign metals influence the accuracy of the results.

My object in these notes is not to insist on any particular application, but to bear testimony, from a metallurgical point of view, to the delicacy and simplicity of the instrument which Prof. Hughes has placed at our disposal; and I would offer him my sincere thanks for the liberal aid he has so readily given me.

WE have received from Messrs. Paterson of Bedford Court, Covent Garden, a catalogue of the electrical apparatus manufactured by them. In drawing up part II. of the catalogue, which chiefly has reference to electric signals, Messrs. Paterson have given a brief explanation of the principles on which electric signals for houses, mines, &c., work, and a few instructions for fixing the same, which renders the catalogue something more than a mere price list and make it a useful pamphlet for all who require to fix electric signals, but who have but little knowledge of the proper way to do so.

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* *Ann. de Chimie et de Phys.* t. xxiv. 1823, p. 343.

† *Ibid.* t. xxxix. 1828, p. 274.

‡ *Instruction sur l'Essai des Matières d'Argent par la Voie Humide.* Paris, 1830.

THE TELEGRAPH IN NORWAY.

By P. TH. BOWITZ.

AMONG the nations of the earth Norway occupies but a subordinate position. Even with the modern facilities for rapid travel, measured in time, its distance from New York is about fourteen days.

Since regaining its independence in 1814, Norway has been exclusively engaged in the development of its home interests. Although its resources are limited as compared with most European countries, the advantages of modern improvements and inventions are appreciated and their benefits are earnestly sought to be secured for her. Among these the telegraph is recognised as one of the most important. The first telegraph line constructed in Norway was between the capital, Christiania, and Drammen. This was built in 1854, and was only four Norwegian (about 28 English) miles long. Now the net-work of lines extends all over the country. At the present time the Norwegian telegraph system includes 124 Government or public, and 103 railroad telegraph offices. The latter are employed mainly in railway service, and are not connected with the Government telegraph system.

The needle instrument is the apparatus most generally used upon the railroad lines, although at some stations the Morse register is employed. The operators in these railroad offices are boys and young girls. Their telegraphic knowledge and expertness is small, and their salaries are in proportion thereto.

Of the 124 offices comprised in the Government telegraph system, 16 are open only during the winter to accommodate the herring and codfish fisheries, and one (Oxoe, near Christiania), is merely a semaphore office. Christiania, the capital, is the only city in Norway that has more than one office, and in her case, for only a portion of the year. There, in addition to the central office, during the sessions of the Strothings, or Norwegian Parliament, which, commencing February first, continues four or five months, a branch (Strothings) office is maintained.

Only in Christiania is there continuous day and night service, where it is necessary on account of the connection with the International telegraphic system. Of the other offices 7 are kept open from 7 or 8 o'clock, a.m. (according to the season), until midnight; 41 until 9 o'clock, p.m.; 53 to 1 o'clock, p.m., and from 3 to 9 o'clock, p.m.; and 5 offices have full day service during the fisheries season, about three winter months.

Norway is telegraphically connected with other countries by lines from Christiania and Trondhjem to Sweden, by submarine cables from Arendal to Denmark (Jutland), and from Egersund to Scotland.

The Morse register is principally used, although at a few of the offices, and upon the cable to Scotland, the Wheatstone apparatus is employed. At Christiania and Bergen duplex working has just been introduced.

A new apparatus invented by the Norwegian mechanician, Mr. Olsen, of a character similar to the Hughes, is being tried at Christiania. The use of the register is officially required, as the paper-tape is preserved for the sake of investigation of any errors that may occur. The majority of the operators, however, are able to receive by sound. Every office of course has its signature, as "C" for Christiania, "D" for Drammen, "Td" for Trondhjem, etc. The International alphabet is used, as on most European lines. After sending a message the sender gives his signature, and the number of the message, and a collation of the ciphers and the signature of the receiver are repeated back.

All the offices are well furnished, that of Christiania

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splendidly, as it was formerly the mansion of one of the richest merchants of the city.

The Astronomical Observatory at Christiania has a line connecting it with the telegraph office, and twice a week, Sunday and Wednesday, is for a short time put in circuit with all the offices of the country, and the standard time is transmitted. The time at all offices is thus regulated to correspond with Christiania time.

Four hundred and fifty persons are employed in the telegraph service. Of these one is the director, one intendant, 11 are inspectors, with 264 male and 88 female operators. The salaries of the employés is fixed by the Strothing and is paid at the end of every month. The director submits to the Ministry of Postal and Naval affairs, in which department the telegraphs belong, a budget for the year, which includes everything connected with that branch of the service; and on this basis the estimates are submitted to the Strothing for its action thereon.

In the early years of the telegraph the pay of the employés was small, and those who competed for telegraphic employment were, some of them, possessed of but little learning. At present the salaries are better, and the requirements in reference to the knowledge and ability of candidates more strict.

It might interest the reader to know some of the salaries paid.

The Director receives about	1,930	dols
„ Intendants	1,080	„
„ Inspectors	870	„
„ Managers	650	„
„ Male Operators (second class)	320	„
„ Female „	250 to 350	„
„ Pupils (ladies)	190	„

For managers, and for male and female operators who are not managers, there are some intermediate grades of payment. The salaries paid are not high, it is true, but, on the other hand, the country is not wealthy, and the cost of living is moderate.

Promotion of employés from a lower to a higher grade is based exclusively upon seniority in the service.

In the organization of the service, the director is the chief executive authority, subordinate only to the Postal and Naval Department. This position has been held from the first establishmer.t of the system by the present director, Mr. Carsten F. Neilsen. This gentleman, who is much esteemed and loved by his subordinates, and who is a knight of several orders, was originally a lieutenant in the Royal Navy. When, in 1854, the establishment of the telegraph in this country was discussed, he furnished to the Strothing the plans and estimates therefor, and was appointed to superintend its construction and management, which duty was performed so efficiently and satisfactorily as to insure his retention in the position.

The intendant, Mr. Jonas Collett, has co-operated with his chief, Mr. Neilsen, from the first, and is a most efficient official. The inspectors are superintendents of a certain number of offices, and managers of the offices in the towns in which they reside.

Once or twice a year a school for pupils is opened at an office in a town where an inspector resides. The director advertises in the newspapers when and where the school will be held, how many pupils will be admitted, and the qualifications required of the applicants. The number of pupils admitted is usually 12 to 15. The qualifications requisite are that, if a man, the candidate must be from 17 to 25 years of age; if a female, from 20 to 25 years; must be in good health, which fact is testified to by a physician's certificate; must have passed at least an examination in a lower school (in such schools there is taught English, German, French or Latin, mathematics, history, geography, physics, etc., etc.). It is essential that applicants for admission into the telegraphic service as operators shall understand the English, German, and French languages, and they must be of good character and reputation, which latter must be certified to by responsible parties. The successful applicants for admission into the school receive three months' instruction in a theoretical and practical course, under the direction of the inspector. The latter delivers a lecture of an hour's length daily to the pupils, who are also required to practice six hours daily. At the end of the course the inspector gives each pupil a certificate which specifies their order, exactness, diligence, and progress, and they are then appointed to fill vacancies as they occur.

A pension fund has been established to which all engaged in the telegraphic service are required to contribute, and to the benefits of which all are entitled. To this fund the men are required to contribute about two dollars and the women about one dollar per month. When retired from the service on account of disability or old age, each employé is entitled to a pension from this fund.

The male operators have, besides, a voluntary pension fund, through which the widows of deceased members are provided for. To this fund they contribute 1½ per cent. of their monthly salary. Hitherto the widows entitled to the benefit of this fund have received *yearly* an amount equal to the entire amount contributed thereto by their deceased husbands. It has been possible to pay this high pension, as the operators enter the service at an early age, and generally remain unmarried for several years.

The male and female operators work in the same office, and as they are gentlemen and ladies the effect of their association has proved beneficial and elevating to the tone of the profession. Occasionally such business association results in a more intimate relation being established for life. In one case only are both of a married couple in telegraphic service. The lady operators are all highly educated, and belong to families of distinction. The men employed as operators are most of them graduates from the Royal University, and some of them have other subordinate employment, such as assistants in offices of advocates, banks, or as teachers, editors, &c. In a few instances the telegraph and post offices are combined. Two of the operators are Strothingsmand (Members of the Parliament), which consists of 111 members.

A telegraphic situation was for some years not particularly aspired to, but since the salaries have been raised, the youths have grown to men, the intellectual standard has been elevated and made more uniform, and the service has become an object of public consideration and aspiration.

The telegraph service has been of great importance to the industrial emancipation of females. The first employment of ladies in the service was in 1859. Two sisters, the Misses Breda, paved the way. Previously women were not employed in any public position, now they are found as clerks in the offices of the Ministry, counting-house offices, teachers in public schools, &c. Their admittance in the telegraphic service gave the first shock to the prejudice against their employment with their brethren in public positions; and women are not yet admitted to the privileges of the university.

Operators employed in the day service are on duty from 2 to 9 o'clock p.m., and from 7 or 8 o'clock a.m. to 2 o'clock p.m. the next day. They are then free from duty until 2 o'clock p.m. the following day. In some cases, however, when the operator engaged in the day service has other employment, a special arrangement is made so that their service is only required in the forenoon or afternoon.

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This is, in brief, the situation of the telegraphs and telegraphers in this little country. We do not flatter ourselves that we can teach much to the telegraphers of a country where the electro-magnetic telegraph was invented, and has been so highly developed. It would, however, give us pleasure to know that a little interest is felt, by our telegraphic brothers and sisters in America, in such distant members of the fraternity.—*Journal of the Telegraph.*

A METHOD OF ADJUSTING GALVANOMETER SHUNTS.

By H. R. KEMPE.

THE accurate adjustment of the ordinary $\frac{1}{10}$th, $\frac{1}{100}$th, and $\frac{1}{1000}$th shunts for galvanometers is often a somewhat troublesome operation, in consequence of the numerical values of the resistances of which these shunts are composed not being whole numbers; thus, supposing the resistance of the galvanometer to be 5,000 ohms, then the resistance of the $\frac{1}{10}$th shunt would have to be 5,000 ÷ 9 or 555·56; and, practically, this could not be adjusted to a greater degree of accuracy than one decimal place. Similarly, the $\frac{1}{100}$th shunt should have a resistance of 5,000 ÷ 99 or 50·505, and the $\frac{1}{1000}$th shunt a resistance of 5,000 ÷ 999 or 5·005, both of which numbers are somewhat awkward to adjust exactly. The following method of facilitating the operation I have found to be extremely convenient, and it is, as far as I am aware, novel.

Supposing the resistance of the galvanometer to be G, then the resistance of the shunt necessary to reduce the sensitiveness of the galvanometer $\frac{I}{n}$th should be, as is well known, $\frac{G}{n-1}$. Now, when the shunt is connected to the galvanometer-coil the combined resistance of the two will be

$$\frac{G \times \frac{G}{n-1}}{G + \frac{G}{n-1}} = G \frac{\frac{I}{n-1}}{\frac{n}{n-1}} = \frac{G}{n};$$

consequently to adjust the $\frac{1}{10}$th shunt we may connect it to its galvanometer coil and adjust it until the combined resistance of the two becomes equal to 5,000 ÷ 10 or 500 ohms. Similarly the $\frac{1}{100}$th shunt would be adjusted by connecting it to the galvanometer coil and adjusting it till the combined resistance was found to be 5,000 ÷ 100 or 50 ohms; also, we should adjust the $\frac{1}{1000}$th shunt until the combined resistance was 5,000 ÷ 1,000 or 5 ohms.

The great advantage of this method will be seen when the adjustments are made, as they would be, by the help of the ordinary Wheatstone bridge. Thus the resistance of the galvanometer-coil would be first obtained; using in the two "ratio" arms of the bridge the resistances 1,000 and 1,000; when balance is obtained by adjusting the plugs, the $\frac{1}{10}$th shunt to be adjusted is connected to the galvanometer coil and the ratio in the bridge altered to 1,000 and 100, the other plugs not being touched. The shunt coil is then lengthened or shortened, as the case may be, until it is observed that the testing galvanometer needle again stands at zero, when the shunt will be correctly adjusted. In a similar way the $\frac{1}{100}$th shunt would be adjusted by obtaining balance with the ratio altered to 1,000 and 10, and the $\frac{1}{1000}$th shunt with the ratio 10,000 to 10.

The advantage of this simple method will be found to be very great when practically tried, both as regards rapidity and accuracy of adjustment.

STEWART'S ELECTRIC LIGHT DISTRIBUTION SYSTEM.

THE object of this system is to enable the electricity generated by a dynamo-electric machine (or obtained from any other source) to be distributed through a number of circuits in succession in such a way as to permit of one, or as great a number of electric lights as may be required or found practicable, being established and maintained in each circuit by means of electric lamps. The principle of the system is as follows:—

A rapidly rotating arm, terminated by a spring contact, passes over and presses lightly upon a number of metallic contact pieces or pins insulated from each other and disposed at equal intervals around the face of a disc, and equal in number to the number of branch circuits in which the lights are to be produced in the district. The main wire or cable from the dynamo machine or other source of electricity at the central station, is in electrical connection with the arm of the commutator through its axis.

Now as a luminous object remains for about $\frac{1}{8}$th of a second on the retina of the eye, it is evident that any object which is seen more than eight times in a second will appear to be constantly visible. If therefore the commutator arm rotates, say sixty or more times in a second, a current of electricity will be sent through each of the branch wires sixty or more times in a second, and if one or more suitable arrangements of carbons or other appliances for establishing the electric light be interposed in the circuit of each branch wire, the several lights will appear to be constant, notwithstanding that the flow of the current is intermittent, it being in fact interrupted at the rate of sixty or more times in a second.

Figure 1 shows a vertical section and figure 2 a plan of the rotating switch or commutator.

A is a horizontal disc of vulcanite, mounted on a stand, and B are metallic contact wires or strips of metal disposed radially on the disc at equal distances apart, and embedded in the face of the disc. To each contact B, a branch wire *b* is attached by binding screws, and in each circuit *b* are placed the electric light lamps. C is a spring contact in the form of a comb or brush, and attached to the extremity of a metal arm *c*, and so applied as to touch the contact wires B in succession when carried round by the revolution of a wheel or disc D, to the circumference of which said arm is attached. The disc or wheel D is of metal, and is firmly secured on a vertical steel spindle E, concentric with disc A, and its ends are coned and mounted to rotate between an upper bearing F and a metal footstep G. The foot *e* of the spindle E rests on a gate *g* in the footstep G, which is of cup form to contain mercury,

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FIG. 1.

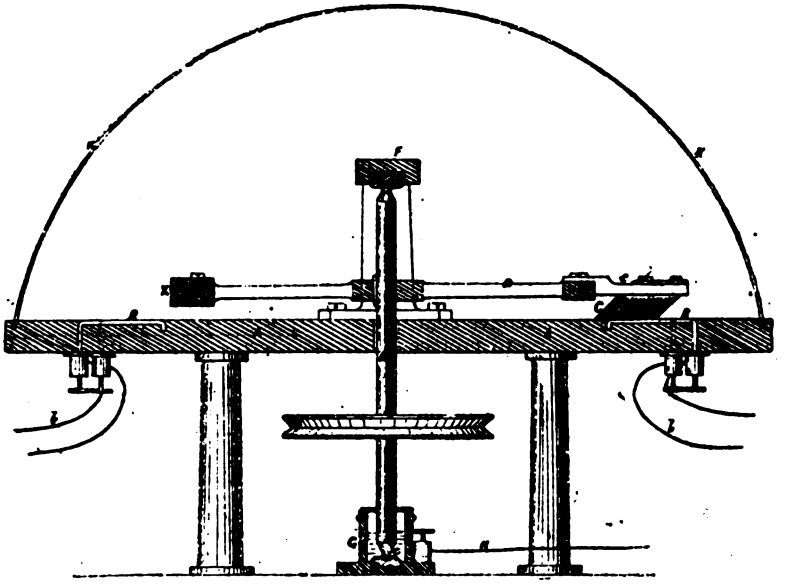
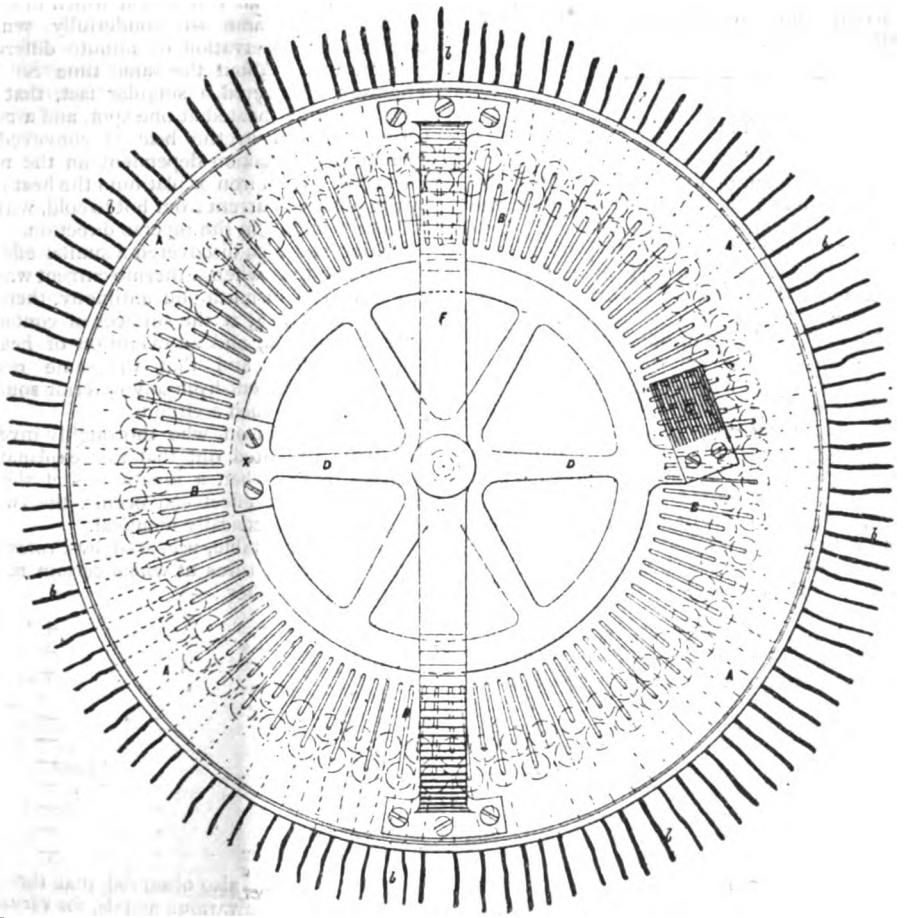


FIG. 2.



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in which the foot of the spindle is immersed in order to electrically connect the metal spindle, and through it the contact C with the main wire H from the dynamo or other machine or apparatus for generating electricity, the wire H being connected by a binding screw with the footstep G.

In order to reduce friction as much as possible, there is an agate bearing for the top of the spindle, which latter is driven from a motor by a belt running on a pulley I fixed on the spindle, or by any other convenient arrangement of gearing. In order to balance the wheel D, a counterweight X is placed on it opposite the arm carrying the contact C.

The speed of the wheel D should be not less than 60 revolutions per second at least to give a constant steady light, but may be as much higher as convenient.

K is a glass shade enclosing the disc A to protect the contacts from the moisture of the atmosphere.

A great advantage in this system of distribution lies in the fact that any fault in any one of the circuits in no way affects the others. It is evident that the system could be applied for "Universal" battery working on a number of telegraphic circuits, so that the latter could all be worked from one battery.

A similar system to the foregoing has also been patented by Mr. J. Munro, with the addition of secondary batteries, or induction apparatus inserted in the lamp circuits to blend the portions of intermittent currents into a continuous stream, so as to obtain a steadier light.

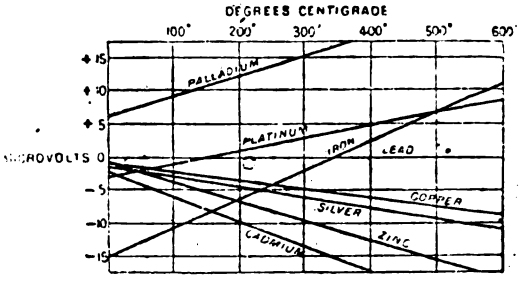
THE RISE OF THE THERMO-PILE.

IN giving a short sketch of the development of the thermo-pile, we shall first say a few words on the history of thermo-electricity in general.

As early as 1707, the thermo-electric properties of tourmaline had been pointed out by a German writer, who, under the initials of J. G. S., published a book entitled "Curious Speculations During Sleepless Nights." Indeed, in ancient days, Theophrastus had shown that tourmaline, like amber, could be electrified by friction; but he does not appear to have had the idea that the electrification might be due to the *warming* produced by friction. In 1759, Alpinus, in Germany, called attention to the same fact, and pointed out that electricity of opposite kinds was manifested at opposite ends of the crystal. In 1760 Canton observed similar phenomena with the topaz; and, towards the close of the century, other observers, notably M. Haüy, showed the thermo-electric properties of various other substances.

It remained, however, for Professor Seebeck, of Berlin, to discover, in 1821, that when the junction of two metals forming part of a circuit was heated, an electric current flowed through the circuit; Seebeck is, therefore, justly regarded as the discoverer of thermo-electricity. The apparatus he employed to illustrate this consisted of a simple frame of antimony and bismuth, with a suspended magnetic needle placed within. The approach of the flame of a spirit lamp to either of the junctions produced a deflection in one or other direction.

Professor Jas. Cumming, of Cambridge, extended Seebeck's experiments, and, in 1823, ascertained that the unequal distribution of heat in the circuit was the cause of thermo-electricity, and he drew up a table of positive and negative thermo-electrics. He also made an important discovery in what is called the thermo-electric *inversion* of various metals at different temperatures, a fact now constantly made use of in the construction of thermo-piles. It means that a metal which is thermo-positive to another at one temperature may be negative to it at a higher or lower temperature. This may be seen from fig. 1, which was given by Sir William Thomson, in



the Bakerian lecture for 1856 (Phil. Trans.). In 1832 Dr. Botto, of Turin, made a thermo-electric battery of platinum-iron pairs; and, in 1834, Nobili devised the compact form of arrangement known as the thermo-pile, an instrument which in the hands of Melloni became so wonderfully sensitive a machine for observation of minute differences of temperature. About the same time Sir William Thomson discovered a singular fact, that when a metal circuit is heated at one spot, and a current is passed through it, the heat is conveyed by the current in a direction dependent on the nature of the metal. With iron or platinum the heat is carried by the positive current from hot to cold, with copper and other metals in the reverse direction.

Peltier had also discovered a similar effect. His theory was, that, when a thermo current was formed in a circuit of bismuth and antimony, there was an absorption of heat at the surfaces of contact at the warmer junction, and an evolution of heat at the colder junction, and that the same result was obtained if a current from any exterior source were passed through such a circuit.

Sir Wm. Thomson, who thoroughly investigated the subject, pointed out that this explanation was incomplete, for, when a junction is at the neutral point, no Peltier effect can occur: the two metals being thermo-electrically identical.

The following table, prepared by Professor Tait, gives the temperatures at which certain metals are neutral to each other:—

Iron	+	357 °F.
Tin	+	45
Brass	+	27
Lead	-	—
Zinc	—	32
Copper	—	68
Cadmium	—	69
Aluminium	—	113
Silver	—	115
Palladium	—	181
German Silver	—	314

Professor Tait has also observed that the thermo-electric lines of the various metals, for varying temperatures, are approximately straight lines, a fact

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which greatly simplifies the calculation of electro-motive forces for any desired combination.

In 1837 Dr. Andrews, of Belfast, found that fused salts could be employed as thermo-electrics, and constructed a battery with platinum wires, dipping into fused salts.

The first patent taken out in this country for a thermo-electric battery, was that of Moses Poole, in 1843. Poole used 100 pairs of German silver and iron rods, cemented in plaster of Paris; the lower ends were heated in a sand-bath, while a current of cold water was kept flowing over the upper ends. This battery was used for depositing metals.

In 1852 M. J. Roberts and C. Watt obtained patents, the former (among other things) for using hot air to excite the battery: the latter, for a combination of antimony and bismuth pairs.

We should also mention that, in 1847, Alexander Bain had employed a thermo-pile for regulating clocks, by means of a plate or lens, driven by train-work, and containing a slot through which the sun's rays passed at certain times of the day. In 1853 H. Krant employed the pile for thermometric measurements.

The first application (and perhaps the only one) of the thermo-pile to telegraphic use, was made by Mr. C. F. Varley, who, in a patent obtained in 1856, described a pile to be used in conjunction with induction coils, for telegraphing over short lines.

In 1862 Dr. Matthiessen read a paper before the Royal Society, in which he pointed out that some substances, such as silver, copper, and bismuth, have their conductivity increased by being heated for a considerable period, while others, such as tellurium, have their conductivity diminished by like treatment. Dr. Matthiessen had previously investigated this and kindred subjects most laboriously, and had drawn up the table given below—the first really accurate one published, most other experimenters having ignored the fact that, in measuring the electro-motive force of any pair of junctions produced by a given difference of temperature between the opposite junctions, the *mean* temperature of the circuit should be constant, or nearly so.

THERMO POSITIVE :—

	Silver and copper = 1.	Microvolts per degree Centigrade.
Galena	— —	
Bismuth	+ 24·96	+ 45 to ·65
Mercury	+ 2·52	+ 4·18
Aluminium	+ 1·28	
Lead wire	+ 1·02	
Tin wire	+ 1·00	— ·1
Copper	+ 1·00	— ·1
Platinum	+ ·72	— ·9
THERMO NEGATIVE :—		
Silver	— —	— 3·0
Graphite	— ·05	
Zinc	— ·21	— 3·7
Iron (piano wire) ...	— 5·20	— 17·5
Antimony	— 9·87	— 23 to 26
Antimony 2, Zinc 1 ...	— 22·70	
Tellurium	— 179·80	— 502
Selenium	— 290·00	— 807

The above table is extracted from Dr. Matthiessen's paper in the Philosophical Transactions for 1858.

Referring to the left-hand column of figures, it will be seen that he takes silver as his zero metal, and, calling the effect of a silver-copper pair 1, he measures the electro-motive force of all the other couples by this standard, those above silver being considered thermo-positive metals, and those below it thermo-negative. The mean temperature was 19° to 20° C.

The right-hand column is a table calculated from this by Professor Jenkin, showing approximately the thermo-electric force of each couple in micro-volts for each degree Centigrade. Professor Jenkin, however, takes lead as his zero instead of silver. The tensions above lead are, therefore, positive, and those below are negative, and to obtain the power of any positive and negative couple we must add the two together; thus bismuth and antimony have a force of 45 + 23 as compared with that of silver and copper, or a tension of 68 microvolts for each degree Centigrade.

(*To be continued.*)

FOX'S ELECTRIC CURRENT METER.

THE principle of this apparatus, the invention of Mr. St. George Lane Fox, is shown by fig. 1. *a* is an electro-magnet, the coil of which forms part of the circuit of the conductor *b*; the amount of electricity passing through which for the supply of say a house at x it is desired to ascertain. c is an armature attached to a spring *d*. This armature carries a cone or wedge *e* working in an orifice *f*. This orifice leads by a pipe *g* to a meter *h*, like an ordinary gas meter, and thence by a pipe *i* to an air chamber *k*. The air in this chamber is kept constantly at a certain pressure, and this may be conveniently effected by means of a water air pump, as shown, that is to say, water from a reservoir *l* in descending by the pipe *m* draws in air by the inlet *n*, and carries it with it into the chamber *k*; *o* is the water outlet pipe; *p* is a valve to the chamber *k*, which valve opens when the pressure increases beyond a certain point. Thus the meter *h* has on one side a constant pressure, and on the other side an outlet at *f*, whose extent depends upon the position of the cone *e*, and, therefore, upon the distance of the armature *c* from the magnet *a*. As has been before explained, when no current is passing, the cone *e* closes the orifice *f*, and when a current of a greater or less strength is passing, the orifice *f* is opened to a corresponding extent, and consequently air, to a like corresponding extent, flows through the meter *h*. Figs. 2 and 3 represent in front and side elevations respectively (fig. 3 being partly in section), the actual form of the apparatus in which the air-chamber is kept charged by means of an electric air-pump, and in which a governor is interposed between the meter and the outlet valve or orifice. In figs. 3 and 4, *a* is the electro-magnet, whose coil forms part of the conductor *b*, the amount of electricity passed through which it is desired to ascertain. *c* is the armature fitted with a weight *d*. This weight is carried on one arm of a bell-crank d^1, d^1, centred at d^2, and the other arm of the bell-crank is connected by a link d^3 to the armature. *c* is the cone or valve, which may either be attached

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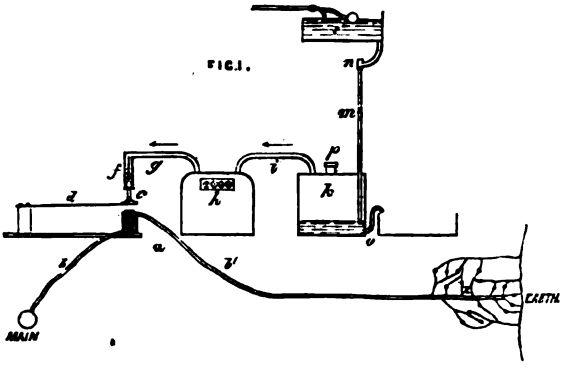
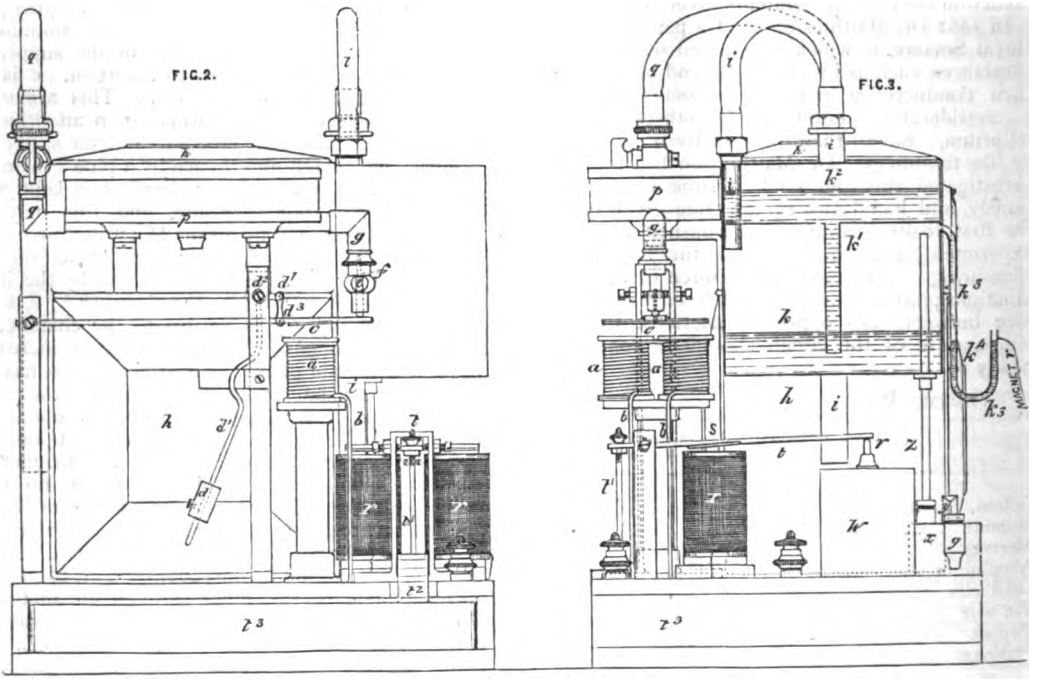
to the armature or simply rest thereon. *f* is the orifice in which the valve or cone *e* works. This orifice leads by a pipe *g* to a governor *p*, which is of the form known as a double dry gas governor, thence by a pipe *q* to the meter *h*, and from the meter by a pipe *i* to an air-chamber *k*. This air-chamber is kept charged by means of an electric air-pump, and this is effected as follows:—*r* is an electro-magnet, and *s* its armature, which is carried

of the mercury in the vessel *x*, as above stated, drives a corresponding volume of air up the pipe *s* to the air-chamber, and the return of air from the chamber is prevented by a suitable valve fitted in the pipe *s*. When the armature *s* ceases to be attracted by the magnet, the mercury, which has been previously forced from the vessel *w* to the vessel *x* returns, air entering the vessel *x* by the pipe *y*, which has a valve opening inwards, and the plunger





by a lever *t* centred at *u*. When the armature *s* is attracted by the magnet, the outer end of the lever *t* presses upon and pushes down a rod *v*, which is attached to a plunger in a mercury vessel *w*, the result of which movement is, that the mercury is forced up in a vessel *x*, which is in communication with the vessel *w*. This vessel *x* is closed, except to an air inlet pipe *y*, and to an outlet pipe *s*, which communicates with the air-chamber *k*. The rising

in the vessel *w* therefore rises and lifts the armature *s* until it is again attracted by its magnet; a pumping action is thus kept up. Instead of having mercury in the vessel *w*, and a plunger to act upon it, the vessel *w* may simply contain air, and the rod *v* be made to act upon a flexible diaphragm in the vessel, so as to compress the air below such diaphragm, and the rod *v* is, in this case, lifted by a suitable spring. The air chamber *k* contains a

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given quantity of paraffin oil, or other suitable liquid, into which a pipe k^1, from an upper chamber k^2, dips, so that, as the air is more or less compressed in the chamber k, the liquid is more or less forced up the pipe k^1 into the chamber k^2, which has an aperture at the top for the admission and exit of air as necessary. In order to break the contact when the pressure in the chamber k reaches a certain point, a syphon k^3, made of metal, but with a glass piece k^4 interposed, is fitted to this chamber. The bend of the syphon contains mercury at such a level, that it makes contact between the two metal portions of the syphon, except when the pressure is sufficient to force its level down into the glass portion k^4; the contact is then broken. The manner in which contact is alternately made and broken, so as to enable the magnet r to alternately attract and free its armature s, and thus effect the pumping action before explained, is as follows:—From the tail of the lever t is suspended by a rod t^1 a plate, or piece of lead t^2, which dips in sulphuric acid or other liquid in a trough t^3. The contact of the lead t^2, with the liquid in the trough t^3, completes the electric circuit, in which are the coils of the magnet r, so that the armature is attracted. As the armature descends, the lead t^2 is gradually lifted out of the liquid, and, as soon as it is quite out of contact, the circuit is broken.

Notes.

THE INTERNATIONAL TELEGRAPH DELEGATES.—The delegates despite the unseasonable weather, are still diversifying their business with sight-seeing and entertainments. On Saturday, July 12th, they were shewn over the West India Docks, by invitation of the East and West India Dock Company. The ships were dressed in their honour, and luncheon was served in one of the large wool warehouses. On Friday, July 18th, the delegates paid a visit to the Camp at Wimbledon, where they were entertained at lunch in the Refreshment Pavilion, by the Joint Reception-Committee of the Post Office and Telegraph Companies. And on the following Wednesday, they went to Liverpool, and were entertained at a banquet given by the Lord Mayor, and a luncheon on board one of the Inman steamers. From Liverpool they then proceeded to Edinburgh and Glasgow.

FOREIGN PROGRESS OF THE ELECTRIC LIGHT.—Werdermann's system has, we believe, been adopted in the Parc d'Acclimatation at Bordeaux, and some day, perhaps, we shall see our own Zoological Gardens lit by the electric light. Jablochkoff's has been installed in the Place Schilles at Vienna. Two electric lights, fed by a Gramme machine, have also been fitted up in the famous Slate Quarries of Angers. The principal gallery of this excavation is 100 metres long by 60 metres high, and from 15 to 30 metres wide. The darkness is profound owing to the unreflective nature of the slaty walls, but the two electric lamps in question, now render the gloomy pit almost as light as noon, day and night. A light sustained by 60 Bunsen cells is to be tried on board the Giffard captive balloon, during its night ascents from the Tuileries.

THE Brush Electric Light has been introduced into the mule and spinning rooms of the Willimantic Linen Company's Works at Cleveland, Ohio. A No. 5 machine, costing 1200 dollars, is used. It gives six lights of 2000 candle power each, four of which are in the mule and two in the spooling room. In the former room 60 and in the latter room 76 gas jets are displaced.

EDISON'S LIGHT.—Mr. Edison is stated to have partially overcome the obstacle to his electric light offered by the high price of platinum. His lamps, instead of costing several dollars each, as at first, can now be made of an alloy of platinum with inferior metals, so as to cost only 56 cents. He announces that he can now produce the spiral coil for incandescence at a price which all who use gas can easily afford, and that his efforts to find platinum are only induced by the desire to reduce the cost of burners still further. Mr. Edison has been so quiet of late that we have not given up all hopes of his ultimate success.

THE Electric Lighting Company has failed.

THE TELEPHONE.—A number of new telephone stations have recently been opened in Germany. In Brazil, also, many plantations and business houses have been fitted up with it, and Gower's form, as constructed by Messrs. Breguet and Rodde, has been adopted by the Count d'Eu, commander of the military forces of that country.

M. Bramão, telegraph engineer of Lisbon, and better known as the inventor of Bramão's telegraph, which we illustrated on April 1, has devised a new telephone which is said to surpass most of those in vogue, the reproduced speech being heard at a distance of twenty metres from the receiver. It requires no call but the voice.

EDISON'S TELEPHONE.—A company to work this ingenious invention has been incorporated under the name of "The Edison Telephone Company, Limited." It is to continue for twenty years, the capital being 100,000 dollars divided into 1,000 shares. They also purpose to buy and use other telephonic apparatus in Europe and elsewhere. This telephone was publicly exhibited for the first time in America at the closing Spring meeting of the Franklin Institute, on June 18. The *Philadelphia Times* states that whistling, speaking, and cornet playing was heard as if only a partition full of holes or cracks intervened between the audience and performers. On June 1, a concert was also held between Sacramento and Red Bluff (Cal.), 135 miles distant, with this apparatus. The English instrument has not been exhibited lately, owing, we believe, to a lack of prepared chalk, only one cylinder having been brought over from America. While upon this subject we may mention that Mr. E. H. Johnston, the able assistant of Mr. Edison, has come over from America as Edison's European representative.

THE TELEPHONOGRAPH of M. Lagriffe is said to be an experimental success. It consists of a telephone circuit which transmits speech with a force sufficient to impress it on an improved phonograph, which repeats it if desired. We are not told whether or not loud speaking is obtained by this arrangement.

COWPER'S TELEGRAPHIC PEN.—In commenting upon the claim set up by Professor Dolbear for privity and invention of this apparatus, the *Journal Telegraphique*, after referring to our repudiation of that claim, cites the fact that M. Hasler had published in the October number of that journal a description of a system called the *pantographe electrique*, which contains the principle of Mr. Cowper's invention, that is to say, the reproduction at a distance of characters by means of a pen

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whose movements are ruled by the rectangular co-ordinates of each point in the design to be transmitted. The *Journal Telegraphique*, however, very agreeably observes that "despite the evident identity of the principle adopted by Mr. Cowper and M. Hasler, we have not received from the latter any claim of priority of invention, and our only aim in mentioning the fact here is to show how difficult it is in a new invention to avoid clashing with an old idea."

THE HUGHES INDUCTION BALANCE.—A complete induction balance has now been installed at the Royal Mint, and Mr. Chandler Roberts is sedulously engaged in testing its capacities for physical assaying. His results will be communicated to the British Association in August. On another page we give his recent note, read before the Physical Society, on the examination of tin-lead, silver-gold, and copper-tin alloys. Mr. Grove, the authorised maker of the balance has a number of orders on hand for home and foreign universities, and several of the delegates, including Dr. Brunner von Wattenwyl, are going to take instruments home with them.

JUSTICE TO MR. PRESCOTT.—In a recent number we took Mr. Prescott somewhat severely to task for, as we believed, publishing his reply to our criticism of his most recent work, *The Speaking Telephone*, without also giving the critique in question, as well as the critic's response to it. We are glad to learn, however, from the American *Journal of the Telegraph*, in which his reply was republished, that Mr. Prescott himself was not responsible for its appearance there. The *Journal of the Telegraph* says: "Whatever impropriety or injustice there may have been in omitting the criticism, we would say, in justice to Mr. Prescott, he is not responsible for it. The publication was made by the editor without any suggestion from him, and without any knowledge, other than that of any reader, of the manner in which it was to be made, until after the paper was printed." The editor adds that Mr. Prescott is not responsible for anything that appears in that organ except those articles signed by him. This statement of Mr. Ashley will correct a notion which is very prevalent here.

WE have received the Journal of the *Telegraph Electrical Society* of Melbourne. It is chiefly taken up with papers and paragraphs on the electric light, the first being an introduction to the subject by Mr. L. S. Daniel, the hon. secretary and treasurer.

THE Telegraph Construction and Maintenance Company's ship *Calabria* has sailed for the Cape with the Mozambique-Zanzibar section. The steamer *Scotia* has also sailed with a portion of the new Australian duplicate cable of the Eastern Extension Company, and on July 22 she had reached Aden.

"WIRED LOVE," a romance of Dots and Dashes, is the title of a small telegraphic novel by Miss Thayer, an American female operator. It is brightly written, and shows some power of sketching.

THE *Operator* states that Rutger's College has conferred the honorary degree of Ph. D. on Mr. Edison.

THE same journal hears that a compromise is likely to be effected between the American Bell Telephone Company and the Gold and Stock Telegraph Company.

A NEW automatic type-printing telegraph has been invented by Prof. R. E. House, of Binghamton, N. Y. It is called the House Postal Telegraph, because of its being peculiarly adapted for postal work. The message is punched, or rather, "slit" out on a tape of paper, which is put into the sending instrument and reproduced in the receiving instrument; but this copy of the original tape is then inserted into a third instrument, which prints the message in Roman letters ready for delivery.

THE Japanese government intend to connect the Loochoo Islands with Kagoshima, Japan, by a submarine cable.

THE CANADIAN MARITIME TELEGRAPH.—The contract for the construction of the new shore line in the maritime provinces to connect lighthouses on prominent points with the telegraph system of Canada, in aid of which the Canadian Parliament last session voted a bonus of 20,000 dols., has been awarded to the Dominion Telegraph Company. The construction of this line is the first step toward the completion of the scheme for connecting the Island of Anticosta and Magdalen Islands with the shores of the St. Lawrence by telegraphic communications, and for which purpose Parliament has voted a subsidy of 15,000 dols., to be continued annually. This system has been inaugurated by the government with a view to rendering timely assistance to vessels in distress, thereby lessening loss of life and destruction of property.

THE Russian Special Telegraphic Commission has recommended a large extension of lines throughout the Empire in three classes. The first class, 21,340 versts and 410 stations, to be finished in five years, at an outlay of 840,000 roubles yearly; the second class, 16,485 versts and 129 stations, costing 2,260,820 roubles; and the third classs, 12,822 versts and 90 stations, at an outlay of 4,853,950 roubles, for completion as found practicable. These lines are very distant, little used, but important for the Government.

THE ELECTRO-MOTIVE FORCE OF MERCURY ALLOYS.—Mr. Hockin and Mr. Herbert A. Taylor have been engaged in a long series of experiments suggested by the curious, but well-known fact, that the amalgamation of a zinc plate generally renders the zinc more electro-positive than it was before amalgamation, while at the same time it protects the plate to a great extent from the action of dilute sulphuric acid. Their results show that potassium, sodium, cadmium, tin, and copper, are rendered more electro-negative by amalgamation. Lead and the other electro-negative metals are little altered. Iron and zinc are rendered distinctly more electro-positive in dilute sulphuric acid. In zinc sulphate zinc is not altered by amalgamation. The authors conclude that, within narrow limits, mercury alloyed with any number of metals takes the place in the scale of electro-motive force of the most electro-positive metal that it may contain, if the amount of the electro-positive metal present is not less than about $\frac{1}{1000000}$th in weight of the mercury. This seems explained by the facility with which a mercury surface becomes polarised, and the tenacity with which it retains the hydrogen. Also, if any zinc or other impurity exists on a portion of the surface of a mass of mercury exposed to an electrolyte, the whole service will fall to the potential of the zinc or other the most electro-positive impurity present. These laborious and important experiments of Messrs. Hockin and Taylor, are fully published in an original communication in the last number of the Journal of the Society of Telegraph Engineers.

AN ELECTRIC STONE DRESSER.—Mr. J. G. Cranston, engineer, of Newcastle-on-Tyne, has invented a machine which is worked by a dynamo-electric machine, and which he claims will dress millstones or other

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stone, and drill rock economically, with rapidity, precision, and despatch. The chisel employed is fastened to a spring arm, which protrudes from a case containing magnets and armatures. This spring arm, when the magnets are connected with the dynamo-electric machine, moves up and down with extreme rapidity, causing the chisel to strike a blow at each descent. The inventor states that it can be made to strike from one to two thousand blows per minute. Wires being used in place of steam pipes, enable the apparatus to be moved readier to any angle, or worked at any reasonable distance without much loss of power; while not the least meritorious portion of the whole invention is the horizontal frame or base to which the electric apparatus is fixed. This frame is portable, and by the use of screws can be so adjusted as to cause the chisel to strike any portion of a circle with either a swift or slow motion, the number or intensity of the blows being regulated according to the softness or hardness of the stone. By the use of this machine, Mr. Cranston claims that he can cover a millstone in a very short space of time with the necessary grooves and furrows, having the straightness, regularity, and parallelism so much desired in good millstone dressing. The apparatus can be worked either automatically or by hand, so as to suit the varying natures of the stone being operated upon.

New Patents—1879.

2674. "Improvements in signalling apparatus and in the arrangement of circuits to be employed in connection with telephones." S. PITT (communicated by L. Anders). Dated July 2.

2697. "Indicating railway stations in the carriage by means of electricity, the apparatus being worked from the guard's van, or rendered self-acting upon the train entering the station." F. M. ROGERS. Dated July 3.

2744. "Improvements in the construction and action of electric lamps or lights, or mechanism connected therewith." G. WHYTE. Dated July 5.

2769. "Improved means and apparatus for electric lighting." H. E. NEWTON (communicated by H. W. Cook). Dated July 7.

2821. "Improvements in and relating to apparatus for automatically opening and closing electrical circuits, chiefly designed for use in the electro-deposition of metals." G. ZANNI. Dated July 10.

2878. "Manufacture of magnetic stays, corsets, bodices, and other female and male garments for the relief and cure of disease." W. WILSON. Dated July 15.

2905. "Electrical apparatus for medical and other purposes." C. H. CARLSON. Dated July 16.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.—1878.

4041. "Electro-magnetic engine for driving rotary hair brushes." W. North. Dated Oct. 12. 2d. An armature frame is caused to revolve by making and breaking inducing magnets. (*Not proceeded with.*)

4043. "Applying electricity for lighting and heating." St. G. Lane Fox. Dated Oct. 12. 6d. This describes a plan for retaining the heat on the platinum electro-pyres or electric burners by coating the surface with some thermal non-conducting material such as asbestos, fire-clay, lime, steatite, or some vitreous material. Asbestos platinised or saturated with conducting material is also used. A fine coil of wire of platinum, &c., may also be used for the light emitter, either bare or coated with the above materials. A regulator for the current is provided by means of a copper or silver rod plunged into mercury, and enclosed in a glass vessel. The rod dips into the mercury less or more according to the strength of the current, thereby inserting more or less resistance in circuit.

4046. "Obtaining electric light." G. P. HARDING. Dated Oct. 12. 2d. This describes an idea for pushing forward electrodes by means of the buoyant power of liquids. (*Not proceeded with.*)

4047. "Apparatus for regulating electric light." G. P. HARDING. Dated Oct. 12. 6d. This describes a current regulator formed of a metal wire arranged to expand and contract by heat due to the current, so as to throw in or take out of circuit a shunt which carries away a portion of the current from the burner.

4066. "Magneto-dynamo electric machines." J. IMRAY. Dated Oct. 14. 6d. In a suitable framing two flat discs of copper are fixed at some distance apart with projecting electro-magnets set round. Between is rotated two smaller discs of copper carrying armature bobbins set round. The inner or revolving magnets are equal in number to the outer inducing ones. In order to reduce the force necessary to separate the poles of the revolving magnets from those of the stationary ones, it is of advantage to use half the number of the former and to fix them obliquely, so that while one pole of each is facing a pole of one of the stationary magnets, the other pole of the former is facing the opposite pole of the stationary magnet next in order. Instead of winding each armature core separately, a bundle of the insulated wires may be wound in a zig-zag manner over one notch of each core, and thence over the opposite notch of the next, and so on round the whole circumference so as to include all the cores in one circuit.

4074. "Indefinitely dividing electric currents." ANTOINE ARNAUD. Dated Oct. 14. 2d. This consists in arranging the circuit so as to obtain uniformity in all parts. Both conductors are connected to the positive pole, one directly as usual, the other through the work to be done by each section of the circuit. The current then follows a parallel course in the two conductors, passing from the first to the second by the work to be done, and thence along the second to the end of the circuit before returning to the negative pole.

4075. "Galvanic batteries." J. H. JOHNSTON (communicated by W. W. Griscoin, New York). Dated Oct. 14. 8d. This describes a box battery, which permits the exciting liquid to flow through the cells intermittently or continuously from suitable reservoirs.

4094. "Producing and regulating electric currents." J. L. PULVERMACHER. Dated October 15. 8d. This describes improvements on the batteries of the author (*see* patent No. 3469, of 1877), and in the construction of electro-motor engines, metallic hair-brushes, and the employment of a magnetic balance in timekeepers.

4095. "Galvanic batteries." F. H. W. HIGGINS. Dated October 15. 2d. On account of the liability of most of the common metals to oxidise at the surface in connection with carbon in moist places, the connection is faced with a thin washer of platinum-iridium, soldered on one side of the nut which screws on the wire from the zinc plate; this wire passes through a hole in the carbon, and the ring is pressed against the carbon plate by the tightening nut. *(Not proceeded with.)*

4114. "Dividing and distributing electric currents for lighting, &c." E. J. C. WELCH. Dated Oct. 16. 2d. A number of circuits are fed consecutively with electricity by means of a rotating contact. *(Void.)*

4140. "Electrical apparatus." W. SCOTT. Dated October 18. 2d. This describes a contrivance for distributing electric currents. It consists of a compound

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bar made of metals which expand by different degrees when heated. The bar is bent in the form of a helix, and fixed at one end, while the other is attached to an arm. The current is passed through the bar, and, by heating it, works the arm. This arm is fitted with sliding contacts, which vary the resistance in two or more rheostats. One of the rheostats is connected with a branch circuit which passes through the compound bar, and thus expanding it by change of temperature, increases the resistance it meets with by the movement of the arm, and is thus retarded, so at the same time the current on the main wire from the generator by the same movement may pass in increased quantity by the reduction of the other rheostat resistance. Thus the current is automatically controlled.

4161. "Commutator for submarine telegraphy." E. EDMONDS. Dated Oct. 18. 2d. A communication from Count Siccardi, Turin. This describes a new arrangement of the keys illustrated in patent No. 275, 1878. *(Not proceeded with.)*

4163. "Electric lighting." J. N. ARONSON, H. B. FARNIE. Dated October 18. 4d. This describes the use of ruthenium, osmium, and rhodium, as an imperishable substitute for carbon. The metals singly, or alloyed, or mixed with plaster of Paris, &c., may be used as points, or else rendered incandescent by passage of the current through them.

4202. "Application of electricity to pneumatic apparatus for sounding bells." Dated October 22. 4d. The author proposes to combine battery or magneto-electro machine with the keyboard of a console and a pneumatic arrangement in connection with the strikers or bell hammers, whereby the pneumatic apparatus may be placed in the most convenient position contiguous to the bells, and to actuate it from a console placed at any distance therefrom. *(Not proceeded with.)*

4206. "Magneto or dynamo-magneto electric machines." R. P. HIGGS. Dated October 22. 2d. The conductor and magnet of this machine are caused to rotate as a solid body, instead of the magnets remaining fixed and the conductor rotating. *(Not proceeded with.)*

4210. "Speaking telephones." J. F. BAILEY, New York. Dated October 22. 6d. This describes a telephone similar to Phelps' "Crown" form.

4212. "Lighting by electricity." C. T. BRIGHT. Dated Oct. 22. 2d. The main current is passed through an induction coil primary; and the secondaries are connected to the lamps, which consist of glass vessels filled with rare gases, such as nitrogen, or vapours of phosphorous, mercury, ether, or volatile hydro-carbons.

4226. "Developing electric currents, and lighting by electricity." T. A. EDISON. Dated Oct. 23. 1s. This describes the tuning fork generator of Edison.

4240. "Electric telegraph apparatus." W. R. LAKE (a communication from F. Tommasi, Paris). Dated Oct. 23. 6d. This describes Tommasi's sensitive relay, in which a very small magnetic bar is placed between two powerful electro-magnetic poles. The bar acts as the relay tongue.

4278. "Apparatus for electric lighting." E. J. C. WELCH. Dated Oct. 25. 6d. This describes a distributor formed of two series of contact pieces, one fixed the other rotary. These split up the current amongst a number of separate currents consecutively.

4304. "Dividing and distributing the current produced by galvanic batteries." C. E. SHEA. Dated Oct. 29. 6d. This describes a plan for dividing a current among several circuits by a rotating contact, which passes rapidly across the ends of these circuits. *(Not proceeded with.)*

4313. "Obtaining and applying electricity." A. A. COCHRANE. Dated Oct. 26. 2d. This describes a plan for generating electricity from evaporation of liquids, and storing it in Leyden jars for electric lighting, or other purposes. *(Not proceeded with.)*

4315. "Apparatus for producing light by electricity." B. P. STOCKMAN. Dated Oct. 26. 2d. This consists in keeping carbons together by floating them in mercury or other liquids. It may be applied to parallel candles. *(Not proceeded with.)*

4316. "Electrical arrangements." J. W. CADETT. Dated Oct. 26. 6d. This describes a means of obtaining increased electric force by condensers joined up in series. The charge in the condensers is regulated by resistance inserted by an automatic electro-magnet.

4317. "Lamps for lighting by electricity." F. D. TILLEARD. Dated Oct. 26. 2d. This describes a metal lamp case for the electric light in travelling carriages. *(Not proceeded with.)*

4338. "Obtaining light by electricity." C. W. HARRISON. Dated Oct. 28. 2d. This consists in using fluid conductors for electro-pyres, or electric light burners, and interrupting their continuity by a vibratory or other movement so as to give a succession of sparks or flashes sufficiently rapid to produce a continuous light. Mercury is used as the conductor and the vapours are suitably condensed. *(Not proceeded with.)*

4344. "Gas batteries for the production of electricity." F. J. ODLING. Dated Oct. 29. 2d. Two extended surfaces of carbon are separated by an acid or saline solution. One is exposed to hydrogen, and the other to air. Electricity is generated by the reaction of the H and the O of the air, and led from the carbons by conductors. *(Not proceeded with.)*

4346. "Manufacture of telegraph cables." E. BERTHOULD, F. BOREL. Dated Oct. 29. 6d. This consists in forming submarine cables by drawing out a primitive ingot composed of the core and sheathing to any required length. The whole is encased in a soft metal tube such as lead, the insulator may be resin, powdered glass, or sulphur.

4347. "Apparatus for producing electric light." J. S. WILSON. Dated October 29. 6d. This describes an electric lamp in which two carbon electrodes are kept together by a spring, controlled by electro-magnetism.

4348. "Secondary galvanic batteries." J. S. WILSON. Dated October 29. 2d. The plates of this battery are of iron, and the liquid is a solution of nitrate of soda, mixed with a saturated solution of sulphate of soda, the acid of which makes a soluble salt with iron. *(Not proceeded with.)*

4367. "Telephones." J. F. BAILEY, New York. Dated October 29. 6d. This describes a carbon telephone similar to Mr. Edison's.

4388. "Producing electric light." S. F. VAN CHOATE. Dated October 31. 4d. This describes electro-pyres of asbestos, mica, platinum, carbon, or combinations of these. The electro-pyres are made in bands, balls, discs, &c. *(Not proceeded with.)*

4407. "Applying electricity as a source of heat." A. M. CLARKE (communicated by C. Davis, Paris). Dated October 31. 2d. Heat is obtained by the passage of a current through platinum conductors or from the sparks of an induction coil.

4438. "Preparing gutta-percha for insulating telegraphic conductors." E. T. TRUMAN. Dated November 2. 4d. This consists in preparing it without mastication, which is injurious. In this improved process the gutta-percha is reduced to a spongy, porous mass, during the cleansing operation, and then twisted by a special machine. This twisting expels the air from the pores without injuriously kneading or disturbing the natural grain of the gum.

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City Notes.

Old Broad Street, July 29th, 1879.

ANGLO-AMERICAN TELEGRAPH COMPANY (Limited).—In anticipation of the meeting of this Company the report has been issued. It says: "With £3,587 brought forward, the total receipts of the half-year were £298,393, showing an increase of £25,120 compared with the corresponding period of last year, while the expenses were £54,592. The sum of £75,000 has been added to the renewal fund, and a quarterly dividend of 2 per cent. on the Preferred, and at the rate of 4 per cent. per annum on the ordinary stock has been paid. A second quarterly dividend of 2½ per cent. on the former, and at the rate of 5 per cent. on the latter stock, will be paid on the 1st proximo, leaving £11,300 to be carried forward. In view of the approaching competition of the new French Company, and to facilitate the increased number of messages expected from a lower tariff, it has been determined to lay a new cable next year, for which the shore ends and part of the intermediate types of the 1865 and 1866 cables will be available; while the deep sea section, which will be of the latest improved type, will be paid for out of the renewal fund. The duplex system of telegraphy, invented by Mr. J. B. Stearns, and applied to the cable laid in 1874, has been taken over by the Company as from the 1st March, 1879. The royalty to be paid to Mr. Stearns during the life of his patents, for their use upon the whole of the Company's system, amounts at present to £1,300 per annum, the maximum payment being limited to £1,500 per annum. The system will be gradually extended to the whole of the Company's cables."

DIRECT UNITED STATES CABLE COMPANY.—The report of this Company, to be presented at the fourth ordinary general meeting, to be held at the City Terminus Hotel, on August 1st, says: "With this report the directors, submit the usual statements of account for the half-year ending 30th June, 1879, which, with the half-year's accounts to the 31st December last, presented at the ordinary general meeting on the 21st March last, show the financial result of the second year's working of the Company. For the half-year the revenue, after deducting outpayments, amounted to £87,706 3s. 2d.; for the corresponding period of 1878 the amount of revenue, after similar deductions, was £79,852 11s. 5d. The working and other expenses (exclusive of cost of repairs), interest on loan, and income tax, &c., amounted for the half-year to £20,523 5s. 10d., leaving a balance of £67,182 17s. 4d. as the net profit for the half-year; making, with £5,273 8s. 4d. brought forward from the previous half-years, a total of £72,456 5s. 8d. In the corresponding half-year of 1878 the expenses and payments above mentioned (also exclusive of cost of repairs), amounted to £20,065 17s. 9d. The cost of repairs for the half-year, amounting to £8,965 9s. 11d., has been paid for out of, and is charged against the reserve fund. Three quarterly *interim* dividends of 1¼ per cent. each, amounting to £45,532 10s. 0d., have been declared and paid at the usual times during the financial year, and a final dividend of 5s. per share is now proposed, making, with the three *interim* dividends, 5 per cent. for the year, being a total distribution of £60,710. The appropriation of the above balance of £72,456 5s. 8d. on the revenue account is thus shown:—*Interim* dividend for quarter ending 31st March last, £15,177 10s.; final dividend now proposed, £15,177 10s.; carried to reserve fund, thereby increasing it to £100,000—£34,756 4s. 3d.; written off preliminary and arbitration expenses, £5,000; carried forward to next account, £2,345 1s. 5d.; total, £72,456 5s. 8d. The agreement with the Dominion Telegraph Company of Canada, referred to in the last report, has been completed, and came into operation as from the 1st January, 1879. The break in the Company's main cable, which occurred on the 4th January last, was repaired on the 20th March, and the interruption on the 12th February last, of the short section, was repaired on the 22nd April. Both sections of the cable are in good working order.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPHS WORKS COMPANY (Limited).—It is announced that, after deducting the usual depreciation on buildings and machinery, the net profit made by this Company, in the six months ending 30th ultimo, is, subject to audit, £18,800. Of this sum the directors propose to distribute an *interim* dividend for the half-year of 10s. per share, being at the rate of 10 per cent. per annum, leaving £3,200 to be added to the £9,049 brought forward on December 31st last, and making the balance now to be carried forward £12,249.

THE EASTERN TELEGRAPH COMPANY (Limited).—At the fourteenth ordinary general meeting of this company, held on July 14th, the chairman, having moved the adoption of the report, an abstract of which appeared in our last issue, and the same having been seconded by the Marquis of Tweeddale, said in answer to questions by shareholders: Is there any other question to be put? Well, then, I may say to Mr. Newton, in the first place, that I think we have shown you that there is an increase in the stations alone of 12 stations, and I think that the gross increase that we shew you is £6,000 odd. Then there is —— Mr. Newton: £6,160 in the half year; that means £12,320 per annum. The Chairman: Yes; quite true. Well, if you take 12 stations, and take them at an average of £500, you have £6,000 to begin with, and if you take the loss of £7,000 on exchange you have the net amount without any difficulty. As to fluctuations in the exchange it is very difficult for me to give an opinion. The wisest men at the present moment are baffled by this question of silver, and if there is any hon. gentleman who can throw any light on the subject I am sure that it will not only be acceptable to me and the Board generally, but also acceptable to a great many others who are deeply interested in the trade; but I may mention to you that we have not been idle and have not been thoughtless on this particular question, and we have entered into an arrangement now with the Indian Government which will give more favourable terms to the company as regards the value of the rupee. Mr. Newton: That leads me to another question. Have you some arrangement with the Government that they take any risk of the fluctuations in the price of silver and in the value of the rupee? As I understand it you collect your revenue in Calcutta in rupees. We cannot take any benefit from the Government in that respect; we must take the chance if the exchange is 1s. 6d. And I do not think that we ought to consider that we make a loss on exchange unless you, for convenience in the accounts, take the value, say at 20d., which is 1s. 8d. in our money, but received abroad in the rupee. We certainly must take the risk of it being remitted home, like any merchant, unless the Government is so kind as to give us an increase on the value to that prevailing in the markets abroad. That is what I mean—not that we take any benefit from anyone, but that we take our chance like any merchant. The Chairman: I think that if you asked any merchant who sends out goods to Calcutta he will tell you that it is a question of the exchanges where he makes a loss where otherwise he expected a profit. But the Indian Government forms part of our joint purse; and in future we have arranged with the Government that it is to be taken at about 1s. 7½d.,

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and, therefore, any variation below that must be to our detriment; but above it, as it is now, it is in our favour. Now, gentlemen, I think those are the only two questions I have been asked, and I hope that I have answered them satisfactorily. The resolution for the adoption of the report was then put to the meeting and carried unanimously. The question of the Cape cable was then discussed at considerable length, Mr. Newton remarking on the want of a limit to the increase of preference and debenture capital when compared with the ordinary capital of the Company. He also said, "Seeing the tremendous influence of our directors, I am amazed that, as to that part of which so much is made, the influence of the directors with the Government has not produced us a better bargain; and it would seem that the influence is not worth so much, seeing the results of this new undertaking; and the sooner you get on your board two or three more gentlemen of consummate mercantile capacity (hear, hear), the better will it be not only for you, sir, and your Company, but for every member of telegraph property." The chairman then proposed the following resolution:—"Resolved, that the several provisional agreements referred to in the directors' report, and submitted to this meeting with the Lords Commissioners of Her Majesty's Treasury, the Colonial Governments of the Cape of Good Hope and Natal, the Portuguese Government, and the Sultan of Zanzibar, with respect to a line of submarine telegraph between this Company's station at Aden and Natal, and the arrangements mentioned in the report as to the making, laying, and working of the cables, be and the same are hereby approved and adopted so far as the same relate to the matters and things to be done by this Company, and that the board of directors be and they are hereby authorised on behalf of this Company to complete and carry into effect the said agreements and arrangements, with or without any modifications or alterations from time to time required or approved by the board; and also to make and carry into effect any other agreements and arrangements with reference to the said cables which the board may think desirable; and also to subscribe for and accept on behalf of the Company shares and debentures of the proposed Eastern and South African Telegraph Company; and to raise, by the issue of debentures of this Company or otherwise, such moneys as may be required for those purposes or any of them, and apply the same accordingly as the board shall from time to time deem expedient." Sir James Anderson seconded it, and, after some further critical remarks by Mr. Newton, it was put to the meeting, and carried with one dissentient. The usual vote of thanks then brought the proceedings to a close.

The Eastern Extension Telegraph Company (Limited) notify that the Six per Cent. Debentures, due on August 1st, will be paid on or after that date, on presentation at the Consolidated Bank.

The Eastern Extension Telegraph Company (Limited) notify that their Java-Darwin cable is now repaired, thus restoring direct telegraphic communication with Australia and New Zealand.

The *Faraday*, steam screw cable ship, has returned to Messrs. Siemens Brothers' Telegraph Works, Charlton, after having successfully laid 200 miles of the shore end of the new French Atlantic cable in course of being laid down from St. Pierre to the United States. The *Faraday* will shortly begin to take on board the first portion (about 1,000 miles) of the deep sea cable, and is expected to make three voyages before France and America are placed in direct and independent communication.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 53¼-53⅜; Ditto, Preferred, 82¼-82½; Ditto, Deferred, 26¼-26½; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 7⅞-8¼; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1⅞-2¼; Direct Spanish, 10 per cent. Preference, 10¾-11¼; Direct United States Cable, Limited, 1877, 10⅜-10⅝; Eastern, Limited, 7⅛-7¼; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 103-106; Eastern, 6 per cent. Preference, 11¾-12; Eastern Extension, Australasian and China Limited, 7⅞-8; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; German Union Telegraph and Trust, 7⅛-8; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 10¾-11¼; Great Northern, 8¼-8¾; Indo-European, Limited, 20¼-21½; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 9-10; Submarine, 229-234; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference 7⅛-8⅛; Ditto, ditto, Second Preference, 7⅛-7⅜; Western and Brazilian, Limited, 2¾-3¼; Ditto, 6 per cent. Debentures "A," 96-100, Ditto, ditto, ditto, "B," 89-94; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 118-122; Ditto, 6 per cent. Sterling Bonds, 107-109; Telegraph Construction and Maintenance, Limited, 30-30½; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2½-2¾; India Rubber Co., 12¾-13¼; Ditto, 6 per cent. Debenture, 106-109.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
June, 1879 ...	45,000	11,021	2,400	1,025	15,000	36,635	26,485	19,618	... ...	10,661	... ...	9,379	5,057
June, 1878 ...	41,480	11,124	3,175	793	12,840	31,118	23,269	18,582	... ...	10,350	... ...	... ...	3,884
Increase	3,520	... ...	... ...	232	2,160	5,517	3,216	1,036	... ...	311	... ...	... ...	1,173
Decrease	... ...	103	775	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness.)

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 157.

THE RESERVE FUNDS OF THE CABLE COMPANIES.

RECENT occurrences in connection with submarine cable enterprises have had the effect of directing the attention of all thinking men, interested therein, to the future of our submarine cables, and also to the present state of the reserve or renewal funds of the various companies.

It is thought by some of our leading practical electricians, that, in a few years, nearly all existing deep-sea cables will have become useless for telegraphic purposes; and others estimate that the life of these electrical conductors will endure for ten or even twenty years yet. Whatever length of time they may last, and this will vary according to the kind of cable and the ground on which it is laid, it is certain they are at present anything but permanent property. Many hundreds of miles of cable have already become totally useless, and without going much into details we may mention that of the seven cables laid across the Atlantic some are quite defunct, while as we are writing, two are in need of repair, and only two are left to do the whole message traffic from Europe to the United States and the Dominion of Canada.* As a general rule, cables laid in shallow waters are very liable to breakage, but, on the other hand, they are easily repaired. With deep-sea cables, although faults are comparatively unfrequent, the repairing is almost impossible owing to the outer covering and sheathing becoming weakened by decay. Last year an expedition composed of the s.s. *Seine* and s.s. *Calabria* failed to repair the 1866 (Atlantic) cable, and returned to this country on the 27th July, 1878. "The failure was caused by oxidation of the iron wire and decay of the hemp of which the outer covering of the cable consisted." So stated the report of the Anglo-American Telegraph Company.

It may be urged that cables will eventually be made more lasting, or that they may be made much cheaper, so as to permit of total renewals at comparatively frequent intervals, or it may be possible to obtain more sensitive instruments to enable work to be done after faults have shown themselves; but so exquisitely sensitive are the instruments now used that we fancy little can be hoped for in this direction.

Having considered to some slight extent the durability of the cables, the next point which demands notice is that of the reserve or renewal funds of the various companies. Taking the amount of the capitals together of four of the principal companies, having mostly submarine cables rather than land-lines, and the bulk of whose capital is invested in the sea, we find it to reach the considerable sum of over £15,360,000, whilst the reserve funds of the same companies also added together, amount to £731,659.

It cannot be said that directors are to blame for paying excessive dividends; for, with the exception of three companies, two of which pay 6 per cent., and the remaining one 17½ per cent., none of the companies pay over 5 per cent., and two or three pay nothing at all on the ordinary shares.

Nor can it be maintained that the reserve funds are at all adequate to complete renewal, for, doubtless, directors see as well as we do that, unless the receipts increase very remarkably, there is little likelihood of their being able to add any adequate amounts to the reserve funds, and at the same time satisfy their respective shareholders with dividends. The question then arises,—if the traffic returns do not increase, what is to become of those enterprises where no sufficient allowance has been made for renewal? Are they to lapse, or will the Government step in, and, for the sake of retaining our telegraphic communications with the rest of the world, and particularly with our colonies and foreign possessions, subsidize and sustain them, or, purchase existing rights, and, relaying the cables where necessary, work them itself?

The question is one of vast and ever increasing interest, alike to directors, shareholders, electricians, and all engaged in connection with submarine telegraphy—to the whole world, we may say—and the more the directors are aided in their difficult task, by the shareholders, the better will it be for all concerned, and particularly for the shareholders themselves. It would be living on in a Fool's Paradise not to look this serious matter boldly in the face. The Trust companies holding telegraphic securities must also necessarily be affected by whatever affects the success of those companies whose securities they possess.

BRIGHT'S TYPE-PRINTING TELEGRAPH.

THE principle upon which this apparatus, the invention of Sir C. T. Bright, is worked, is decidedly novel: it is briefly that of causing the letters to be printed by inserting different artificial resistances into the line circuit at the sending station.

Fig. 1 shows the transmitting apparatus at the sending station. It consists of a key-board, the keys

* Since writing these lines, communication by a third cable has been restored.

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of which are of ivory or wood, so as to be insulated from each other, and are marked with the letters of the alphabet. Each of the keys is fixed upon a metallic spring *a*, one end of which is connected to a resistance coil *b*. The other end of each resistance coil is connected to earth. Immediately beneath the keys, and along the entire key-board, there is a metallic bar *c*, *c*, moving on centres *d*, *d*; when at rest it is pressed by a spring against the metallic plate *e*, which is connected to earth. A metallic pin *f*, attached to the under side of the spring of each key, breaks the connection between *c* and *e* when any of the keys is depressed, and contact then being made between *f* and *b*, the resistance coil belonging to the key is placed in the circuit.

Fig. 2 shows the working parts and connections of the type-printing instrument at the receiving station; *a* and *b* are the coils of a differential relay, and the upper portion of the figure represents a local circuit, made or broken by the armature lever *c*. The lower portion also shows some of the parts comprised in the upper portion, and these are indicated by the same letters. Coil *b* is connected to the line wire, and to the pole *d* of a battery whose other pole *e* is connected to earth. Coil *a* is also connected at one end to *d*, and at the other end to

FIG. 1.

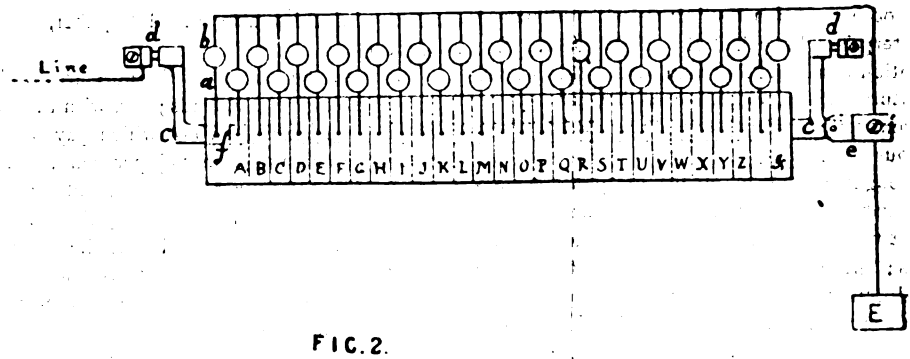
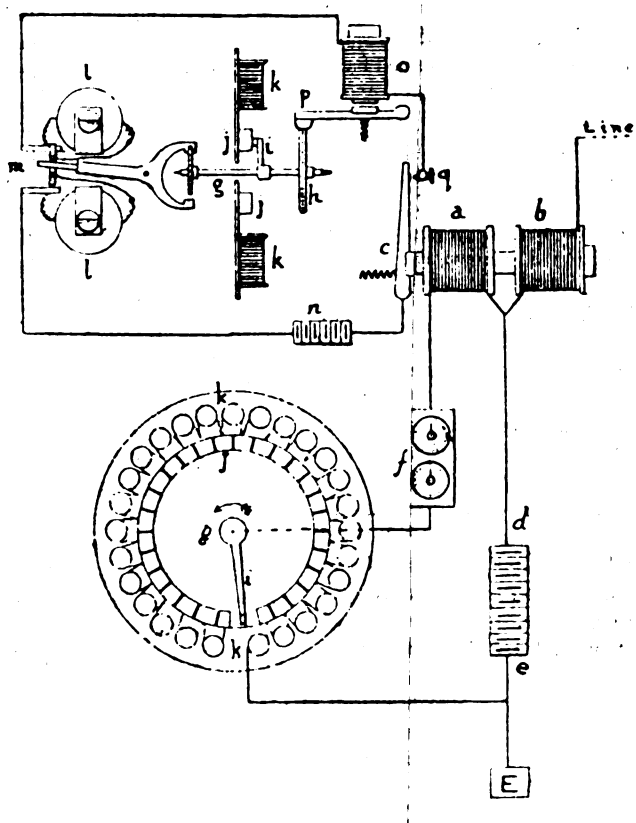


FIG. 2.



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the adjustable rheostat *f*, composed of resistance coils which can be adjusted to equal the resistance of the line circuit, and can be varied to compensate for any change in the latter. The other end of *f* is connected to an axle *g*, *g*, upon which is fixed the type-wheel *h*, and also a metallic arm *i*, *i*, which, when the axle is in motion, passes over and makes contact with a series of metallic plates *j*, *j*, *j*, to which are connected a series of resistance coils *k*, *k*. Two or more type-wheels may be carried by *g*, *g*, so that two or more duplicates of a message may be printed simultaneously. *l*, *l*, is an electro-magnet, and *m* its commutator; *n* is a local battery by which *l*, *l*, is worked, and the axle *g*, *g*, rotated thereby when the local circuit is closed by the action of *c*. A train of clockwork may be controlled by *l*, *l*, in place of directly propelling *g*, *g*; *o* is an electro-magnet acting upon the printing pad *p*. When the instrument is not at work, *c* is in the position shown in the figure, but, upon a resistance being inserted at the sending station, the local circuit is completed by the motion of *c* against the stop *q*, and *g*, *h*, and *i* rotate until *i* comes into contact with the particular plate *j*, by which the amount of resistance inserted at the sending station is equalled, whereupon the current passing through *a* and *b* being balanced, *c* is separated from *q*, the movement of the type-wheel ceases, and the paper is impressed against *h* by *p*.

NEW TELEPHONE CALLS.

M. PERRODON, a French captain of artillery, has invented a system of telephonic aarm which furnishes very good results in its application to military service, and which has for its exciting organ a sort of electro-magnetic trembler constituted by the telephone itself. It is an improvenent of the system of MM, Dutertre and Gonault suggested a considerable time ago; and it is greaty owing to the ingenious arrangements of M. Trouré the constructor of the apparatus, that its success is so marked.

Fig. 1 represents a section of the instrument, with the mouthpiece removed in order the better to display the mechanism. The mouthpiexe is shown above the rest of the illustration. The magnetised bar of the telephone is shown at B, the bobbin at C, and the alarm arrangement at K. This arrangement is worked by a hand lever E, pivoted horizontally, and carrying at F and G perpendicular projections or contact cams. When the instrument is set for speaking, as indicated by the position of the handle *a*, which is then directed towards the etter T, inscribed on the case of the telephone, the cam G presses a spring H, fixed on the bottom of the box of the telephone and which communicates with the wire of the bobbin C. When, on the contrary, the instrument is arranged to give an alarm, a condition in which the handle is turned in the reverse direction to that in which it was during speaking, it is the cam F which comes into contact with a little claw connected to the spring-lever K fixed to L and raises it. This lever raised at K touches with its platinum point the centre of the diaphragm of the telephone at a small platinum contact-stud fixed to it; and forms with the latter a trembling circuit interrupter. The connections are joined up in such a way, that when contact has been established between the diaphragm and the spring in question, the current from a local battery traverses the bobbin of the telephone in such a manner as to produce an enfeeblement of the magnetisation of the magnetic core, and the result is a withdrawal of the

FIG 1.

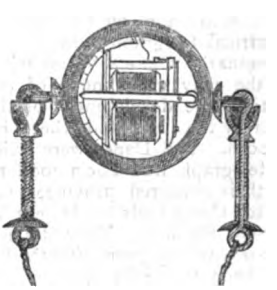

FIG. 2.

diaphragm, which thereupon breaks contact with the spring, and, consequently, the magnet recovering its strength again draws the diaphragm into a new contact with the spring, which in turn determines a new break.

There is thus produced a decided vibratory movement which transmits successive jets of current through the line, sufficiently powerful to cause the

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diaphragm of the receiving telephone to emit sounds capable of furnishing a serviceable call-signal.

This effect only takes place, it must be remembered, when the handle *a* is turned towards the letter A. When turned in the opposite direction, the local battery is withdrawn from the circuit, and the line is put directly in connection with the bobbin B, by the stem E and the spring H, permitting the two telephones to exchange conversation directly.

M. Trouvé has, to a slight extent, modified this arrangement by making the trembler quite independent of the telephone; and for this purpose he employs the tiny trembler, which he has already applied to his exploring apparatus designed to search for projectiles sunk in wounds caused by fire-arms. This little apparatus, which is represented in fig. 2, which is enclosed in a box of clear thick glass, is introduced into the circuit of the battery and telephones. It may even serve as a commutator for the axle worked by the hand, and is furnished with contacts for that purpose. The position of the handle perpendicular to the armature (fig. 1), corresponds to the alarm, and shews in consequence that the battery, the telephones, and the trembler, are all in the same circuit. An oblique position of the handle, either to left or right, establishes telepone correspondence only, and cuts the battery out of circuit. The arrangement of the alarm trembler shewn in the figure would be of little use to the army or to households, so M. Trouvé, for these new applications, has dispensed with the small glass box, and now encloses it in a little case of hard rubber from 3 to 4 centimetres long by 1½ centimetre wide, and completely steam and water-tight. Thus protected, it can sustain violent shocks, suffer the inclemency of the atmosphere, heat, humidity, and even be exposed to rain or snow without losing its power of action. It is, besides, so small that M. Trouvé has inserted it into the handle of the telephone.—COUNT DU MONCEL in *La Lumière Electrique*.

THE TELEGRAPH IN DENMARK.

By CARL HANSEN, Fredericia, Jutland.

TWENTY-FIVE years ago, on the 1st February, 1854, the first electrical telegraph wire was opened to the public in Denmark, where a visual telegraph had for years been the only rapid mode of communication. Since that time the development of the system has been well worthy the little land where Hans Christian Orsted was born. The Danes were quick to see that the electric telegraph would be a good means for connecting all their scattered provinces closer together. The uninitiated shook their heads here as elsewhere at the prospects of the wire. They did not dream that Denmark, hardly twenty years after the first telegraphic message had been transmitted, should become an important link in a great international telegraph system.

On the 17th March, 1852, the bill concerning the erection of an electro-magnetic telegraph in Denmark was issued; but although Sweden only commenced to consider the subject a year later than Denmark, she opened her first telegraph wire between Stockholm and Upsala on the 1st August, 1853, whereas Denmark only opened hers on the 1st February, 1854. The Danish line was, however, of a considerably greater length than the Swedish one. Some difficulty arose from the choice to whom the work should be given; but at last it was resolved that one of the officers of the Royal Engineers should direct the whole work. The line was an underground one, with cables over the "belts" or straits which separate the different provinces from each other. It was no easy task to begin on account of the slender experience which had been gained of the whole matter, and especially of submarine cables, for only one had as yet been laid, viz., between Dover and Calais.

The wire was successfully laid down through Seeland, Fione, and a part of Jutland, when fault of insulation compelled them to take it up again. They had also to fight with the public ignorance of electricity; and the difficulties that arose from this fact were not slight. It was found, for instance, necessary to get a bill to protect the new buildings, and to fix a penalty for its destruction. This bill was issued on the 29th December, 1853, and four weeks after, the line, which had been finished at Christmas, 1853, was opened to the public. The joy caused by this event was nevertheless very short lived, for the very day it was opened it broke down again. Luckily the fault proved to have been caused by a slip of earth in the neighbourhood of Aabenraa, in Schlesvig, and the fault soon repaired.

In 1855, Denmark was in direct cable communication with Sweden and Norway, and the international traffic of these two countries was thus directed through Denmark, which then commenced to play the part with regard to international telegraphy, which her situation seems to have fitted her for. The new traffic carried, however, new obligations for her, obligations which Denmark has never hesitated to bear, as she is well aware of the great benefit proceeding from a great transit traffic through her territory.

The underground system proved itself more and more a failure, for even if it was sometimes possible to transmit thirty telegrams an hour, yet this achievement was rare, and the leading men, of whom the deceased director Faber was the head, laid new and better plans for a complete alteration of the system. Their object was to build an aërial line 628 miles long, with a length of wire of 1,700 miles, and 24 offices, in the year 1856, and the new line was really finished in time and opened on the 1st January, 1857. With the over-head line they had also to encounter many difficulties caused by the stormy climate, so that very often only one wire could be employed. The poles rotted, and fell in great number every time it blew a gale, the insulation was very defective, and the rusty wires broke down; and, when the year 1860 arrived, they were almost as bad with the aërial as before with the underground.

The successful laying of the direct Danish-English cable in 1860, with Flensborg and London as terminal points, by which more traffic passed across the country, gave new courage and strength to the leading men, who saw the necessity of introducing improvements, since the countries which charged us with their telegrams had a right to request that frequent disturbances and delays should not interrupt the communication.

The result of all this was the present system with impregnated poles, meant to stand some twenty or twenty-five years; porcelain insulators of a new construction, the screw of which was invented by a Danish labourer; and galvanised iron wire. Both the poles and insulators are manufactured in Denmark. The poles themselves are cut in the great woods, near Soró, Seeland, where they are treated after Boucherie's method, in an establishment founded in 1861, whence more than 50,000 poles have now been sent out. The Danish porcelain manufactories have finished about 200,000 insulators for home use, besides many thousands more during the earlier years to Sweden

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and Norway. The new aërial telegraph system, which is completed over the whole country, has proved very satisfactory. It was finished in the year 1863 after much labour and toil. Everywhere the eye meets the silent wires through which news are carried to the most retired part of the country.

At one of the Telegraph Conferences at Paris, the Prussian Director of Telegraphs affirmed that he had nowhere found such a beautiful telegraph system as in Denmark.

The following figures will illustrate the activity of the Danish telegraph system, from its beginning in 1854 till 1877:

	1854.	1863.	1865.	1877.
Stations	9	83	68	246
Instruments	14	134	104	266
Staff	25	144	119	372
Telegrams	20,043	222,653	193,956	982,274
			Miles	Kilos.
Length of line	284·00 / 457·00	1118·00 / 1798·862	828·23 / 1332·693	3·224
Length of wire	308·00 / 495·57	2903·2 / 5271·2	1877·28 / 3020·544	8·937

Of the stations 121 are government offces, 121 are railway stations, and four are semaphore posts. The reduced figures in 1865 are caused by the loss of the two Duchies Schleswig, and Holstein.

In the war with Germany and Austria in 1864, the telegraph was busily engaged in a difficult undertaking for the first time, viz., to maintain the connection between the different parts of the army; and everybody agreed that it solved the problem in a very satisfactory manner. War stations were erected everywhere with the army, from the beginning of the war till its end. They kept their posts to the last at Dannevirke, at Als, and at Fredericia, during the retreat of the army through Jutland, and maintained communication until the very moment when the enemy occupied them. A special telegraph service has now been established in the Engineers' corps of the army, in which the telegraphist conscripts work off their service, and are made under-commanders, so that the army has always a staff of practical telegraph clerks at her disposal. The war which reduced our frontier so considerably, extended the telegraph system on a great scale. New wires were put up and many new stations erected in all towns and larger villages. Along the railways of Fyen and Jutland is a special wire set apart for public traffic. On points that are of importance to navigation there are semaphore stations which receive communications from passing ships and transmit them by telegraph to ship owners; and every day the meteorological office at Copenhagen receives reports from numerous posts of observation all over the country, and sends the results abroad.

Ship-owners and everybody to whom it may be of any use can receive daily, for a moderate payment, reports from the meteorological institute. Why the internal telegraph traffic in Denmark may possibly seem somewhat small compared with other countries, such as Sweden and Norway, is not very difficult to understand. In these two countries the towns are far from each other, and the post is unable to satisfy the requirement of speed, while this is more easily fulfilled in Denmark, where railways and good roads connect all the chief points with each other, and the post is able to carry letters in cases where the telegraph under other circumstances would have been employed.

In the early days of the telegraph, the payment for a telegram was rather dear, 2s. 2d. for twenty-five words; but time has altered this too, and every time the tax has been reduced, the number of telegrams has shown that the reduction had not lessened the income of the telegraph. In 1860, it was reduced to 1s. 5d. for twenty words, 1866 to 9d., and at last, in 1874, to 7½d. The following figures illustrate the different reductions, and speak for themselves:

	1865.	1875.	1877.
Home telegrams	88,634	385,282	428,739

Denmark employs ladies in the telegraph, but only at the smaller offices. The staff is recruited from all classes of society, but operators must prove, either by testimonials, that their learning taught at school answers to the requirements put upon it, or pass an examination, held every year at Copenhagen and Fredericia. It is a knowledge of foreign languages especially that is needed. English, French, and German must be written faultlessly to dictation. Of course the native tongue is not forgotten, nor is a certain amount of technical knowledge. It is generally young men from fourteen to eighteen years of age, that are practically trained at the different stations. The mode of training clerks proves a very good one, for it is seldom that one finds a clerk who is not able to fulfil his duty in a satisfactory manner, especially among the younger ones. The Danish telegraphists may also be said to be very much esteemed abroad as clever and trustworthy operators. Not only the Great Northern Telegraph Company is served by Danish telegraphists, but Russia too has placed many of them at her Siberian stations at very high salaries, to say nothing about the fact that the Danes were the first who brought the telegraph to the people of the farthest East.

The beginner commences with a salary of 400 crowns (about £25) a year, which is gradually raised. The salaries for the telegraph staff are fixed by the Rigsdag, and the bill is revised every fifth year. The salary of the director is 4,000 crowns (about £225) rising to 5,200 crowns (about £300). The superintendent of Copenhagen 3,800 crowns (about £215); the superintendent of Fredericia 3,000 crowns (about £170); the managers of the more important offices 2,400 crowns (about £140); the two head engineers 2,600 crowns (about £150); head clerks and managers of smaller stations, 2,000 and 1,800 crowns (about £115 and £100). The telegraphists are divided into 5 classes, with salaries from 1,600 to 800 crowns (£90 to £45). All salaries are raised by 100 crowns (about £6), every fifth year until 400 crowns (£25). From an English point of view, these salaries may seem rather small, but from a Danish one, they may, on the whole, be said to be pretty good, much better than they were some years ago; and they are expected to be raised a little more still.

The director and the superintendent of Copenhagen are the only members of the whole staff nominated by the king, and they have a right to pensions; while all the others are nominated by the home ministry. From the salaries of these latter 5 per cent. is taken every year to form a superannuation fund. The state does not do anything yet in this regard, but perhaps time will alter this too, for the telegraph is yet a child compared with other government institutions, and when childhood is passed it is hoped that a better mode of taking care of old *employés* will be adopted. The stations, many of which are given to the charge of post-masters, are open from 7 in the morning till 9 in the evening (Copenhagen and Fredericia being the only two offices that are never closed).

This arrangement will probably be altered too, for the Rigsdag has asked the minister to propose a shorter time of duty on Sundays and holidays for the Post and Telegraph. Even if an eventual proposal

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should be agreed upon I think it will only be applicable to the smaller stations, which are of little importance in international telegraphy. For the others, I think it would be better to extend the time of duty, say till twelve at night. The clerks are on duty seven hours at a time, so that he who has duty in the forenoon is free from duty in the afternoon from two o'clock and *vice versâ*. At Copenhagen and Fredericia where they have night-duty to perform too, the duty is more arduous, but the time demanded of them is about the same, for night duty gives more liberty and extra duty is generally paid for.

As a comparison between the three Scandinavian countries may be supposed to be of some interest, I add some further statistics for the year 1877.

MESSAGES.

	Denmark.	Norway.	Sweden.
Home telegrams -	428,739	552,946	763,294
To foreign countries -	136,438	128,836	153,510
From " "	145,647	142,905	158,892
Transit " "	246,632	3,400	82,379
Meteorological and other service messages -	24,818	48,000	17,768
Total for the year -	982,274	876,087	1,175,843

These figures show that Denmark in proportion to her extent and size is not left behind by the two other countries and that her transit traffic is much greater than that of the others.

STATIONS.

	Denmark.	Norway.	Sweden.
Intern traffic -	129	197	315
Home traffic only	117	197	361.
Of these are:—			
Government offices	121	127	175
Railway "	121	69	501
Semaphore "	4	1	—

LINES.

	Denmark.	Norway.	Sweden.	
Length of line				
Kilometres -	3,224	8,478	10,740	
Length of wire	8,937	15,108	27,809	kilom.

STAFF.

Denmark.	Norway.	Sweden.
563	696	780

THE NEW CABLE STEAMER.

A FINE new cable steamer, built to order for Messrs. Siemens Brothers, was launched from the yard of the makers, Messrs. C. Mitchell and Co., Low Walker, Newcastle, on Tuesday, August 5th, in presence of a large number of spectators, including a distinguished company of ladies and gentlemen from France. The vessel is named the *Pouyer-Quertier*, after the well-known French statesman, who occupies the position of Chairman to the New Compagnie Frangais du Telegraphe à New York, in whose service she will be for the future engaged as a repairing ship.

Although much smaller, the new vessel bears in many respects a resemblance to her predecessor, the well-known cable steamer *Faraday*, also built by Messrs. C. Mitchell and Co., for Messrs. Siemens Brothers, about five years ago, and which has gained the reputation of being one of the most successful vessels afloat. Like the *Faraday*, the new steamer has twin screws, is fitted with rudder at each end, and has bilge keels of a special kind. There are on board two principal cable tanks, and sundry small supplementary tanks for coiling and stowing the different descriptions of cable. Her whole form and structure are unusually strong; and although bearing the highest class both of the English Lloyd's and the French Veritas, she is even stronger than required by these societies. The vessel is built with a curved bow, on which will be fitted a projecting girder with a swivel cable sheave, a similar sheave being also fitted at the stern. On the deck will be placed very powerful machinery of the latest and most improved description for "laying" and "picking up" cables. Arrangements will also be made for steering the vessel both by steam and by hand, and throughout she will be fitted with a complete system of telegraphs. This is an appliance indispensable for such a ship, as it enables those in charge to handle her in the promptest possible manner—a consideration of such vital importance in cable-laying. Taking it as a whole, the *Pouyer-Quertier*, embracing all improvements suggested by the extensive experience of Messrs. Siemens Brothers and their staff, may be considered as complete a vessel of the class as it is possible to produce. The machinery consists of a pair of compound surface-condensing engines, manufactured by Messrs. Thomas Clark and Co., of Elswick, including all the latest improvements in marine engineering, and capable of propelling the vessel at the speed of 10 knots per hour on the most moderate consumption of fuel. The dimensions of the steamer are: Length over all, 260 ft.; beam, 36 ft.; depth, 24 ft. 4 in.; and she will have a burthen of 1,800 tons. As the vessel left the ways, the christening ceremony was gracefully performed by Miss Siemens, daughter of Mr. Carl Siemens, who himself was present as the representative of his firm.

THE RISE OF THE THERMO-PILE.

(*Continued from page* 249.)

BUNSEN, MARKUS, AND STEFAN, in 1865, constructed piles of various alloys, but the first really practical thermo-pile appears to have been that which Mr. Farmer, of America, exhibited in the Exposition of 1867. Mr. Farmer employed German silver and an alloy of copper, zinc, and nickel. This pile lost power rapidly, owing to increase of internal resistance, and the bars frequently broke in cooling.

In 1866, three patents were taken out by Lieut.-Col. James Baker, for various forms and improvements of thermo-piles. Baker was the first to employ the "Stellar" form of pairs, and he arranged them round a cylindrical or polygonal stove, with protecting cylinders of thermo-insulating material. This form is the one now most commonly employed. Baker also made a pile with bars of *one* thermo-electric metal, connected by copper wires.

In 1868, Mr. L. Mure and M. Clamond patented a pile of iron and galena pairs; and, in 1874, M. Clamond obtained letters patent for an improved form of this pile, a detailed account of which we give.

Three patents were taken out in 1872-5, by M. Faure, but are not sufficiently practical or interesting for description. In the latter year, Mr. C. J. Wollaston patented a pile composed of strips of tinned iron and German silver, the strips being set in a perforated fire-tile, and the hot junctions either enamelled or bedded in a non-conducting composition. The heat was supplied by gas, and a gas-

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regulator, controlled either by clockwork or by a peculiar form of galvanometer-needle was used to adjust the supply. Mr. Wollaston also proposed to employ water-cups to cool the outer junctions.

M. Clamond's battery consists of tinned sheet-iron for the positive elements, and an alloy of two parts of antimony with one of zinc for the negative.

The alloy, which melts at 800° F., is cast into bars from 2 to 2¾ inches in length, and from ⅜ths to 1 inch in thickness. The shape and disposition of the elements are shown in fig. 2. Every 20 of these pairs give an electro-motive force of about 1 volt., and are, therefore, nearly equal to one Daniell cell.

The heat is usually supplied by gas, as in fig. 3, or by coke, as in fig. 4; but, in a recent modification, M. Clamond employs a "collector," composed of pieces of cast-iron, among which hot air circulates:

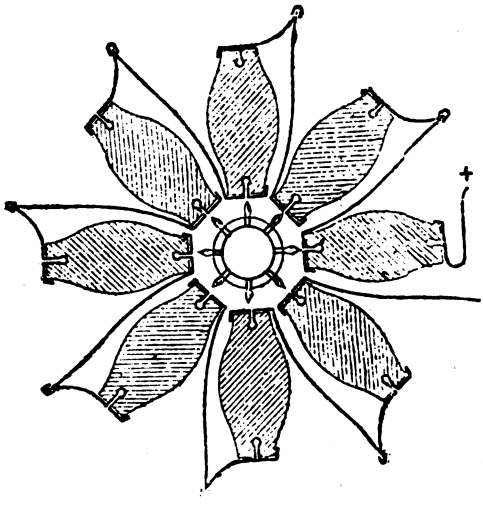

FIG 2.

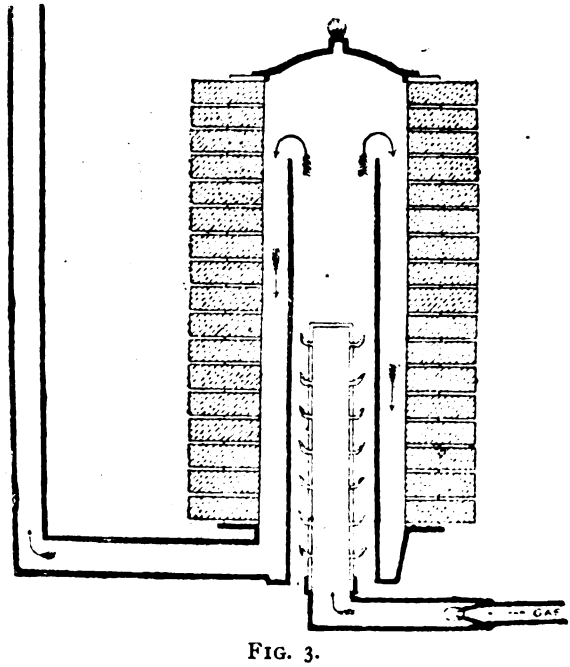

FIG. 3.

a large surface is thus exposed to heat, the iron communicating the heat to the couples.

M. Clamond's latest achievement is the production of the electric light by means of his thermo-electric battery. For this purpose he has constructed a pile of 6,000 small couples, and with it he produces two powerful lights (or four lights of half the brilliancy). The E. M. F. of this battery is said to be 218 volts., and the resistance 31 ohms. Coke is used as the heat source, the consumption being 10 kilogrammes per hour. A small pile of the same number of pairs, and said to be of equal power, consumes only 6½ kilogrammes per hour.

If a thermo-pile be short-circuited, its effectiveness is reduced, the powerful current flowing through it tending to heat the cool junctions and cool the hot ones. In an elaborate and exhaustive paper upon M. Clamond's battery, read by Mr. Latimer Clark before the Society of Telegraph Engineers in 1876 (to which we are indebted for many of the above facts, as also for the illustrations), it was shown that a battery, short-circuited by a resistance equal to its own, had its E.M.F. rapidly reduced by 2·2 per cent. The pile may, conversely, be "polarised," by passing a powerful current through it, the effect being to heat one series of junctions and cool the alternate ones, thus leaving the pile in a condition to give out a sensible current. This follows from what has already been said respecting Sir William Thomson's and M. Peltier's investigations.

One of the chief applications of the thermo-pile is the deposition of metals. Mr. Clark states that in practice it was found that a battery of 375 pairs, having a resistance of 4·5 ohms., and a tension of 14·6 volts., deposited about 180 grains of copper per hour. He also points out, however, that these figures do not represent the effectiveness of the battery, as a similar deposition could have been produced in several successive cells.

In 1876 and 1877, Messrs. C. and L. Wray obtained patents for improvements in thermo-piles. These improvements may be summed up as follows. The bars (alloy of antimony, zinc, and iron) are cast under pressure: this increases the E. M. F. A strip of tinned iron is cast in them, extending nearly through their entire length: this adds materially to their strength, and to some extent increases the E. M. F., and decreases the resistance. The succes sive layers of couples are supported by a metal framework, the weight of the upper layers being thus prevented from falling upon the lower ones. An internal cylinder of earthenware is employed to keep the flame from infringing directly upon the bars, and also to cause the bars to cool more slowly, fractures being thus avoided. The supply of gas and air is regulated, and a wire-gauze chimney is used to prevent explosions.

M. Noë and M. Sudré have intoduced important

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modifications of the thermo-pile; but as these have been fully described in this Journal (June 15 and July 1, 1879), we need not refer to them here.

The following are some of the principal points to be observed in the construction of the thermo-electric battery:—

1. The materials should not be costly.
2. They should not be liable to fuse.
3. They should be protected from sudden heating and cooling.
4. They should not be acted upon by the products of combustion; or they should, at any rate, be protected therefrom, and from the deposition of moisture.
5. The disposition should be such as to allow a defective pair to be easily replaced.
6. The whole combination should possess strength and solidity.

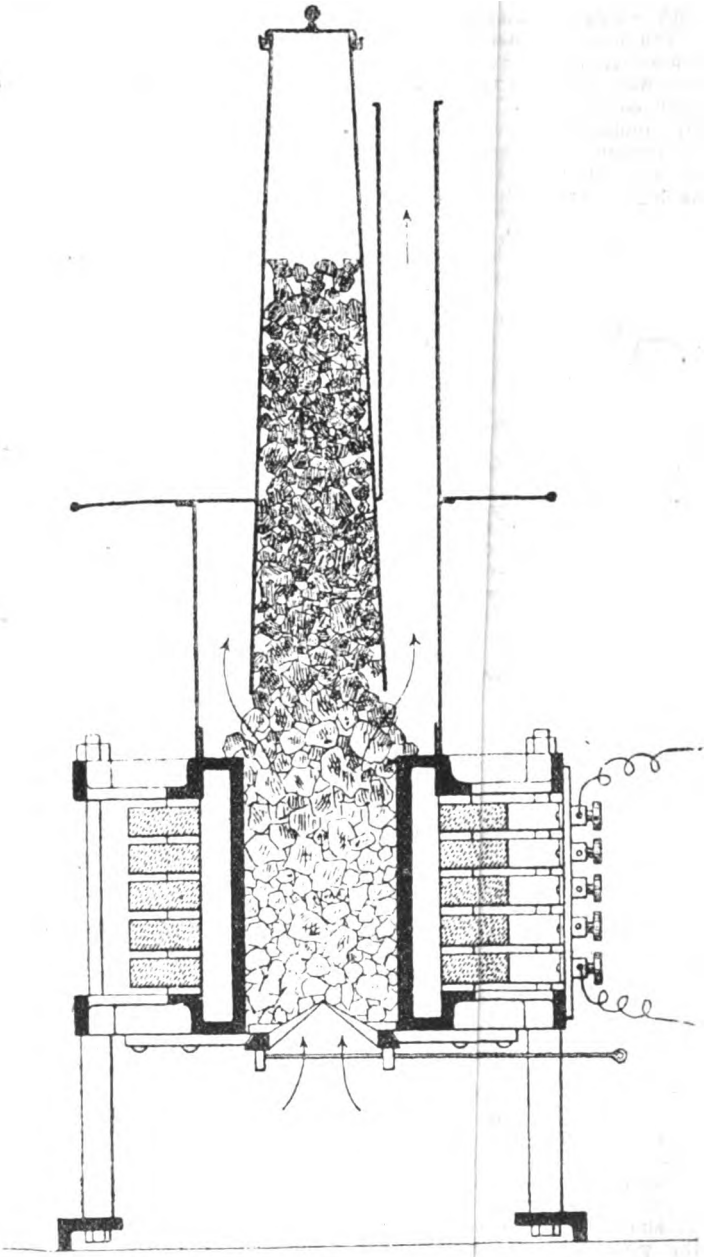

FIG. 4.

The present article is written in the hope that our countrymen will take up the subject and show that this branch of electrical science has not been abandoned to continental inventors.

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Correspondence.

[We do not hold ourselves responsible for the opinions of our correspondents.]

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your Journal of the 15th April, 1877, a simple and novel system of Duplex working, by J. J. Fahie, is described. Of the many advantages which this system is supposed to possess over other existing systems, as claimed by Mr. Fahie, is a very important one, and that is, that "*no condensers*" are at all required to balance the electro-static capacity of a line. This statement is supported by the results of actual trials on some of the telegraph lines in Persia.

To test the utility of the system, some careful experiments *without condensers* were made on the Indian lines. The results were, as anticipated, utter failures.

The failure was due to the fact that the electro-static capacity of the lines could not be baanced by the batteries as described by Mr. Fahie.

If you, or any of the practical electricians are of opinion that "*condensers*" are *actually not* required in the system, I shall deem it a great favour if an accurate explanation of the *theory* be inserted in the columns of your Journal.

You would also oblige me very much by letting me know the electro-static capacity of the condensers (in microfarads) employed by Edison in the *non-polarised relay circuit* of his Quadruplex system.

Also, I shall feel much obliged if you, or anybody else, will kindly inform me, through the medium of your Journal, on the utility of "Double Current" working, as applied to ordinary circuits, that is to say:—

1. Does "Double Current" working *actually* increase speed and the distance to be worked by eliminating the retardation due to the electro-static capacity of the line; and

2. Does the *negative* current employed in the system *actually lower* the insulation of the line? If the latter be correct,

3. What effect has it on the Quadruplex systems used largely in England, America, and other countries worked on the "Double Current" principle?

Yours truly,

"INDIAN TELEGRAPH."

[*No* duplex system, as far as we are aware, has yet been invented which has enabled condensers to be dispensed with when the apparatus comes to be worked on long circuits. In certain cases, it is true, owing to the mechanical construction of the apparatus the effects of the inductive discharge have been less felt, but they have not been neutralised, strictly speaking, but have only been *disguised*, and when a crucial test has been made, such as you have described, the result has proved that the effect anticipated has not been obtained, and a *correct* examination of the theory of the invention would have proved that the inventor's theory is false. Let all the different duplex systems invented be tried under exactly the same conditions, and we believe the effect of the inductive discharge will be found to be the same in all. Condensers, or equivalents to condensers, such as electro-magnetic shunts are, we believe, necessary in any case on long lines if duplex working is to be efficiently and economically (as regards battery power) carried on.

The non-polarised relay has been superseded, and with great advantage, by Gerritt Smith's compound relay. When the former apparatus was employed, the condenser used to "bridge over;" the kick of the armature varied according to the length of the line; about 1¼ microfarads may be taken as the average capacity required.

As regards "Double Current" working on ordinary circuits, the employment of the system does not increase the working speed by diminishing the inductive embarrassment, and even if it did diminish the latter the highest rate at which signals could be sent on any land line, even when retarded, would be much beyond what it would be possible to send by hand or at "key" speed. Double current working is used, not to obtain increased speed but to enable signals to be sent at all under the varying conditions of a long line. In the single current system if the line current varies to any great extent, a constant adjustment of the instrument and armature spring is necessary in order to obtain good signals, or, indeed, to obtain signals at all. With the double current system where polarised relays are employed, the tongue of the latter is set nearly neutral and being equally affected by the "marking" and "spacing" currents, works equally well whether these currents are strong or weak, that is, of course, within certain limits. Also, there being no spring for the current to work against, a very weak current will give good signals.

The negative currents employed in the system do not lower the insulation of the lines, they have no effect whatever on them.]

MORGAN BROWN *v.* JACKSON.

SIR,—Some time ago you mentioned in your journal that the action Morgan Brown *v.* Jackson was to be tried before V.-C. Bacon with witnesses. As these witnesses, it was reported, were to be Sir Wm. Thomson and the like, I looked forward to the trial with great interest, but could never discover that the matter has come to trial. Mr. Jackson's advertisements of a telephone are still to be seen in your journal, so I am at a loss to know how the matter stands, and I am sure that the public would gladly hear something of the state of things in the coming journal of the 15th.

I am, Sir, your obedient servant,

8th August, 1879. H. YATMAN.

[The case mentioned above has not yet come on for trial, but will probably be among the first on the list after the present vacation.—ED. T. J.]

Notes.

THE TELEGRAPHIC CONGRESS.—The labours of the International Telegraph Conference have at last been brought to a close. The conclusions at which the delegates have arrived have yet to be approved by the various Governments concerned, and will not be acted upon until April, 1880. The Conference has decided that the tariff for messages shall be a word tariff, with the addition of a fixed sum or constant, equal to the charge of five words, for the use of the wires. In Europe the length of a word is fixed at fifteen letters, and beyond Europe at ten letters. Words separated by hyphens or apostrophes are counted separately, but in extra-European messages hyphens may be omitted by the sender, although no other departure from ordinary spelling—no contractions, for example—are admissible. Within the limits of Europe, five figures are counted as one word, and any excess over five or some multiple of five is also counted as a word; while, beyond Europe, three figures are reckoned instead of five. It follows that the word "understanding," for example, which contains thirteen letters, would be charged as one word within the limits of Europe, and as two words

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beyond them. The date of the year, containing four figures, would be one word in Europe and two beyond; and such a compound as Aix-la-Chapelle, which would be counted as three words in Europe, might be reduced to two words, on extra-European lines, by the omission of the hyphens. The altered tariff will tend greatly to benefit the senders of short messages, by the abandonment of a *minimum* standard of twenty or some other number of words. Per word, under twenty, the charge will be somewhat higher than it would be if twenty words were sent, because of the constant of five words; but for every message of less than fifteen words the sender will gain. Above twenty words, he will pay precisely the same as under the old rates, with the exception that these were increased by steps of ten words each, while the new rates will be increased by single words. Thus a message of twenty-one words would formerly cost the same as one of thirty; but in future there will be a marked difference between them. It has been found necessary to define code language as consisting of words each of which has a definite meaning of its own, although they may be so combined as not to form any phrase or sentence which will be intelligible to persons who do not possess the key. This provision seems intended to guard against the use of so-called words coined by the sender, each syllable of which may represent an entire word, and the whole an entire sentence, to a previously-instructed recipient. In the same way proper names are excluded from code language, except as used in their obvious signification; as, otherwise, any prohibited combination of syllables might be stated to be a proper name. There is also a provision that every message should have an address of at least two words—one the name of the recipient, and the other the name of the receiving office—in addition to its text. Some of the contrivances adopted by merchants have been sanctioned, so as to avoid disputes; and one example of this is that telegrams need no longer be signed, the last word of each message being accepted, in lieu of a signature, as the character by which the message is to be identified in official communications with regard to it. The order of transmission of messages is laid down as by previous conferences, messages between Governments having priority over all others, then messages on the service of the lines, then private messages marked "urgent," and, lastly, private messages of the ordinary kind. The private messages marked "urgent" are to be charged, as at present, triple the ordinary rates; and each country is left at liberty to recognise "urgency" or not, as its administration may see fit. In England and India urgency is not recognised; but the privilege of priority is given upon the continent of Europe, and it is remarkable that the triple rate is paid upon nearly every Stock Exchange message between Paris and Berlin.

THE ELECTRIC LIGHT IN LIVERPOOL.—The preamble of the Liverpool Lighting Bill, authorising the Liverpool Corporation to raise £15,000 within the next five years, for the purpose of making experiments with electric lighting, has been proved before the House of Lords Committee on Opposed Commons' Bill, Earl Spencer being in the Chair. On July 29, the Bill was read a third time before the House of Lords.

IT has been demonstrated that a 20-light Gramme machine can feed five lights in four radial circuits, each circuit extending two and half miles from the machine.

IN the House of Commons, on July 29, Mr. Chadwick asked the Chairman of Ways and Means whether, in any private Bills passed this session, the monopoly and powers of any gas companies, in regard to gas, had been extended to electric lighting, so as to give gas companies, in case of their undertaking being purchased by any public body, a claim to be paid for any such extra privilege or monopoly; and whether he would report to the House, before any such extension of monopoly rights, was allowed in any Private Bill, whether opposed in Committee or otherwise. Mr. Raikes observed that the question was one of some importance, with regard to the various measures which had been introduced in the House during the present session by various public bodies, with a view of obtaining powers to use the electric light. As many as thirty-five such Bills had been introduced altogether in the present session. It would be in the recollection of the House that a Select Committee was appointed to consider the question of lighting by electricity, and he stipulated with the promoters that, in the event of their Bills being allowed to go forward, all the clauses which related to electric lighting should be struck out; but that if the Committee reported in favour of such powers being given to the promoters of such undertakings, the clauses should be reintroduced at a subsequent stage. The Committee, having reported adversely to the extension of such powers to gas companies, those companies were not allowed to insert clauses, relating to the electric light, in any of the Bills promoted by them; but it had been open to corporations to adopt such clauses as might be found to correspond with the recommendations of the Committee, and in three or four cases they had done so. In no cases, however, was power given to any gas company to make use of the electric light. With regard to the second part of the question, he did not think it would be in accordance with precedent to make a formal report to the House of the cases in which the extension was proposed; but, if he should continue to hold his present office, he would not fail to mention the matter to the House if any such Bill came on for second reading.

THE tour of the delegates in Scotland and the North of England was a kind of triumphal progress, the party being *fêted* at every town they visited. Many large works and places of local interest were visited by them. At Manchester, for example, the great iron factory of Messrs. Richard Johnson and Nephew was thrown open to their inspection, and all the processes of puddling, rolling, wire making, and testing were exhibited, and the party afterwards had an opportunity of descending the adjoining coal pit of Messrs. Johnson and Liveseys.

MUIRHEAD AND WINTER'S quadruplex system has, we believe, been further improved.

MR. STEARNS has taken action against two cable companies for the use of Muirhead's duplex system. The case will be decided in November. The damages laid are £220,000.

THE next International Congress will meet at Berlin in 1884.

EDISON IS STILL EDISON.—Recent reports from America state that the one obstacle met with by Mr. Edison at present to the complete success of his electric light is the high price of platinum for his incandescent coil. No other metal will answer, it seems, so Edison has sent off a dozen explorers to California, New Mexico, and South America to ransack the gulches, with orders to find a large and constant supply of platinum. If they cannot find it on the surface of the

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earth, they have orders to proceed straightway to the interior.

THE NEW ATLANTIC CABLES.—The *Faraday* is at Messrs. Siemens Bros.' Works, Charlton, taking in 1,000 miles of the ocean section. She is expected to make three trips before France and America are directly connected by wire.

MR. BENNET'S yacht the *Jeannette*, which recently left San Francisco for the Paleocrystic Sea, was (says the *Operator*, U.S.) provided with a complete Edison electric light apparatus for the Arctic night, and a Gramme generator.

THE TELEGRAPH IN SAXONY.—The "Imperial Postal and Telegraph Service" extends to all parts of Germany except Bavaria and Wurtemberg, which are independent of the general Government. There were employed in 1875, in the General Post Ofice at Berlin, 191 officials, whose salaries averaged 923 dols. 53c. per annum. Twenty-five received more than 1,000 dols. per annum. The Postmaster-General received 5,735 dols. 80c., besides a house free of rent. The Director of the Post 3,570 dols., and the Director of the Telegraph the same. The *employés* in the service numbered 36,527; average salary, 281 dols. 11c. At the 41 principal cities Postmasters received 1904 dols. per annum, except at Berlin, where the salary was 2,500 dols.; telegraph operators of the first class, 392 dols. 70c.; second class, 285 dols. 60c.; women, 214 dols. 20c.; letter carriers, first class, 285 dols.; second class, 128 dols. 42c. These salaries are slightly increased by Christmas presents, a recognised custom. Formerly the other members of the postal and telegraph service were allowed "extras," but retrenchment has abolished nearly all those perquisites, including "free coffee." In the railway service the superintendent's salary is the highest, 1,581 dols. 68c.; few *employés* receive over 1,000 dols. per annum. Section hands are paid 144 dols. 80c. to 174 dols. 45c. per year. A certain sum is allowed to all *employés* for clothing, and some are furnished with houses and servants. Ticket agents receive 1 per cent. commission on the tickets they sell. The engineers and firemen are allowed for any savings they make in the coal and oil furnished to the trains by the Government. The salary of an engineer is 535 dols. 50c.; firemen, 300 dols.; conductor, 444 dols.; ticket agents, 723 dols. and 609 dols.; freight masters, 571 dols.

EVERY town in the settled districts of Queensland has now a telegraph office, and there is communication with the whole of the Australian colonies. A line now connects Brisbane with Normanton on the Gulf of Carpentaria, 1,425 miles distant, and before very long it is hoped that the wires will be extended to Port Darwin, and so give the Australians the advantage of duplicate land communication with the second cable which it is expected will be shortly laid. When this is done Queensland will be placed in direct communication with Europe and the West. On January 1, 1878, there were in Queensland 136 telegraph sations, 294 officers of various grades, and 40 overseers and men employed in maintenance and construction, 5,033¼ miles of line, and 6,778 miles of wire. During 1877 it appears 512,093 messages were transmitted in Queensland, an increase of 33,020 on the previous year. The intercolonial messages numbered 49,259, the international 406. The revenue was, cash receips, £33,327; value of messages on Government service, £11,794; proportion of international messages, £141; making a total of £45,262. The expenditure was £54,198, showing a loss of £8,936. Up to the end of 1877, the expenditure on lines and stations amounted to £332,283. The charges to any station are 1s. for every ten words, exclusive of name and address, and 1d. each additional word.—*Engineering*.

THE AUDIOMETER.—Prof. Hughes has applied the audiometer to the adjustment of telephones, by connecting the latter in the circuit of the movable coil and moving the magnet to and fro, until the highest degree of sensibility is obtained.

EDISON'S quadruplex system will shortly be tried between Paris and Brussels, under the superintendence of Dr. Cornelius Herz.

IT is now proposed, that naval officers undergoing a course of torpedo instruction on board the *Vernon*, at Portsmouth, shall also be required to familiarise themselves with the practical application of electricity to war. Proper instructions will in time be appointed. The use of the electric light will be an important feature in the training, and experiments have been made with it on board the *Bloodhound*.

THE West Coast of South America cables on either side of Iquiqi, have been cut by orders of the Chilian Admiral.

THE Cape cable has been buoyed at Delgoa Bay.

CLAMOND'S NEW THERMO-PILE, having a heating surface of 20 square metres, keeps two Serrin lamps lit, each giving a light equal to from 30 to 50 gas-jets. The internal resistance is only 31 ohms; the electromotive force 218 volts, or the value of 121 Bunsen cells; and the consumption of coke is 9 kilogrammes per hour.

TRAMWAY CARS driven by electricity, according to the system of Herr Westpfahl, are proposed for Berlin.

ELECTRIC DISCHARGES.—M. Gaston Planté, in a communication to the French Academy of Sciences, recently described the results of his latest experiments on sparks from the Planté Rheostatic Machine. The length of the sparks given by this machine are proportional to the number of condensers employed. With 48 condensers charged by a Planté secondary battery of 800 pairs, he obtains brilliant sparks 0·12 metres long, and if these sparks above an insulating surface powdered with flowers of sulphur, they attain a length of even 0·15 m. In this case they form in their passage a sinuous furrow from 0·002 m. to 0·003 m. wide, and if the insulating surface be a mixture of resin with $\frac{1}{10}$th part of paraffin, they leave a very distinct bluish trace, like a pencil mark, along the middle of the furrow, which permits the course of the discharge to be easily seen. When these sparks are not so long as they can be made, closed branches or derived circuits are observable. There is also a crook or bend in the track of the discharge near the negative pole, which seems to result from the angle caused by two meeting streams of matter proceeding from the excited points, the stream leaving the positive pole being the swiftest. Arborescent forms are also discovered on lightly shaking the insulating powder. They ramify from the main tract or furrow on both sides, and help to explain the tree-like figures sometimes delineated on the skin of persons struck by lightning. These visible paths of the discharge can be easily fixed with varnish. These sparks also pierce glass and

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give at its surface the figures observed by M. Rees's static electricity. Quantity discharges can also be obtained by joining up the condensers in parallel circuit. These are equally brilliant, but do not traverse more than $\frac{1}{10}$ths or $\frac{3}{10}$ths of a millimetre in presenting the appearance of a very brilliant point surrounded with an aureole of flame, and projecting rays of particles drawn from the electrodes. Intermittent discharges passed through a voltameter give a rapid succession of explosions, amounting to a loud sound.

AN application on the part of the West India and Panama Company for Government subsidy to maintain their lines has been refused by the Treasury.

Review.

The Telegraph in America: its Founders, Promoters, and Noted Men. By JAMES D. REID. In memoriam of Samuel F. B. Morse and William Orton. New York: Derby Bros.

THE Americans have not yet proved themselves a great literary nation like the English, or even a mediocre literary nation like the Russians. Perhaps they have scarcely had time, or perhaps the rich stores of England overshadow their own productiveness: for it cannot be said that literature is not encouraged by Americans. They are inveterate and intelligent readers, with a strong tinge of romance in their composition, a keen hankering after dramatic effect; but if the literary ability which is necessary to make books be sadly lacking to our cousins, the material requirements are present amongst them in the highest degree. If they fail egregiously in producing the necessary spirit and genius, they are eminently successful in manufacturing the requisite paper and binding.

The Telegraph in America is a large and handsome volume, about one foot long by six inches wide by two and a half inches thick, and weighing, we should say, about fourteen pounds (one stone). If it were the custom to estimate books by their weight, this were a mighty work indeed. Similarly, if reviewers were in the habit of testing them by the quality of their paper, and the beauty of their gilding, we should have to admit it to be a consummate masterpiece. But books are to be judged neither by their material mass nor the excellence of their stationery; and we must look into the words which are so exquisitely printed on these fine toned pages, and try to gauge their value. In England it is nothing less than an expensive family Bible, or a standard Shakespeare which dares to present an appearance so magnificent as this volume; but we must not forget that, in America, where the literary matter is generally wanting, they do their best to make up for it by the mechanical form.

The origin of the book happened in this wise: On the 10th of June, 1871, the telegraphic staff of the American continent inaugurated the erection of a statue in Central Park, New York, in honour of Morse, the inventor of the electro-magnetic telegraph, and a promise was then exacted from Mr. Reid to commemorate the occasion by a suitable record. This record, which included a history of the Telegraph in America, has taken the shape of the volume in question. Mr. Reid tells us that its preparation has cost him a great deal of labour, and we believe it, for it is a large volume, and the author has evidently striven to make it as original as possible. It deals first with the origin of signals, semaphores, and telegraphs in the world; the life and struggles of Morse; the foundation of the American Magnetic Telegraph Company; the Washington and New Orleans Telegraph Company; and the score of other companies which have had their period of rise and extinction in the United States and Canada, terminating with the Great Western Union Company, the Atlantic and Pacific, and the smaller fry of telephone and exchange companies. Very finely-executed engravings of Morse, Orton, Elisha Gray, and other telegraphic celebrities, profusely illustrate the work, besides many more portraits of less famous electricians, including Edison, Mr. Pope, and Faraday, who is honoured with a vignette woodcut. The book is American, both in style and treatment, and, though it is a history of the electric telegraph, begins dramatically with a rumble of stage poetry and a gleam of enthusiastic sentiment. For example, the first chapter is headed mysteriously, "Before the Dawn-Signal Telegraphs"; and, after the inevitable stanza from the poet (descriptive of the fiery-cross bearer in the *Lady of the Lake*), the author commences his lofty epic—"The first thought of a *bon vivant* as his eye twinkles through a fresh sample of his favourite wine, which with dexterous thumb and finger he holds up to the sun, is 'How old are you?' 'Where grew the grapes which made you?' And he is but a type of an age which seems bent on tracing all things to their origin, hunting them up to their primal nest." We cannot undertake to dispute whether or not these are the first thoughts of a *bon vivant* in gloating over his favourite wine; but, had not Mr. Reid told us so, we confess we should have believed them to be very different. We did not imagine that a *bon vivant* troubled himself very much about the soil his wines grew upon, but we are ashamed to say our knowledge of *bon vivants* is extremely limited. Accepting Mr. Reid's word for it, however, we will do him the justice to appreciate the figure which he has chosen to illustrate the enquiring spirit of the age, a spirit which it would seem has permeated even to *bon vivants*.

Begun with the sentiments of a *bon vivant*, the end of the book is occupied with a lengthy account of all the public honours paid to the memory of Morse, including the flashy eloquence and glittering blasphemy of several pulpit orators. For does it not sound very like blasphemy to say "We send our words to Heaven as we send our messages to Valencia, without knowing in either case how they are transmitted; and, if the Master now walked with us as he walked the plains of Shinar long ago, perhaps we would hear Him say, 'Behold, the Kingdom of Heaven is like the lightning's message.'" Fulminated by a clerical "Jefferson Brick," the spurious glare of a sentiment like this may have been sufferable at the time, but it were better that it should have met the fate of any other squib.

Why a complete list of the subscribers to the Morse Memorial should be appended to the work, we cannot say, unless it is expected that every person whose name is there will buy a copy, or unless these individuals have some faint hope that

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they will in this way enter into immortality *en queue* at the coat-tails of Morse.

We have unsparingly pointed out what seem to us to be the demerits of this book; but we cannot conclude without our meed of praise too. Mr. Reid has taken, evidently, great pains to do full justice to his onerous task, and he has done so with a certain bright originality which, if it leads him to that jerky brilliance so tempting to inexperienced writers, is, at least, refreshing and eminently readable. The vast amount of historical and other information which he gives about the telegraph in America will, we are sure, be highly interesting to English and European readers.

New Patents—1879.

2962. "Joints of pipes for containing underground telegraph wires." A. M. CLARK (communicated by L. A. Herrmann). Dated July 21.

3001. "Improvements in and relating to insulated wires and cables, and in the methods of insulating, fixing, and laying the same for telegraphic and other purposes." W. MOSELEY. Dated July 23.

3023. "Telegraph wires." J. H. JOHNSON (communicated by E. Wheeler). Dated July 25.

3085. "Regulators for electric light." B. J. B. MILLS (communicated by F. Million). Dated July 30.

3132. "A new means of electrical communication between vessels at sea and the shore, or between two or more vessels at sea." S. LAURITZEN, W. C. JOHNSON, G. E. PHILLIPS. Dated August 2.

3164. "An improved method of demagnetising iron ships and composite vessels so as to prevent the deviation of the compasses. E. H. HOPKINS. Dated August 6.

3207. "An improved apparatus for reversing electric currents, chiefly designed for use in connection with submarine cables." W. R. LAKE (communicated by Count E. Siccardi). Dated August 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.—1878.

4502. "Lighting by electricity." E. G. BREMER (communicated by T. A. Edison). Dated November 7. 6d. This describes Edison's electric candle, see TELEGRAPHIC JOURNAL for March 15.

4528. "Telephony." H. J. HADDAN (communicated by G. Black and A. M. Rosebrugh, Toronto). Dated November 8. 2d. This consists in using a "condenser" with telephones so as to utilise an ordinary telegraphic circuit for telephone work. Also in "earthing" the wire of a telephone circuit at several points, so as to diminish the injurious effects of foreign induced currents. *(Not proceeded with.)*

4529. "Telephones and telephonic call mechanism." H. J. HADDAN (communicated by A. M. Rosebrugh, Toronto). To the diaphragm is attached a small permanent cylindrical magnet having an expanded free end, which passes loosely through the centre of the core of the coil. (*Not proceeded with.*)

4559. "Mechanism, &c., for producing light and heat by electricity." C. DAVIS. Dated Nov. 11. 2d. This consists in deriving power from revolving axles or wheels by means of a cog-wheel, for the purpose of turning dynamo-electric machines to light buildings or carriages. (*Not proceeded with.*)

4568. "Electric light apparatus." J. MACKENZIE. Dated November 11. 2d. This consists in floating electrodes on mercury so as to feed the arc. By such means long electrodes can be used. (*Not proceeded with.*)

4573. "Apparatus for electro-deposition of metals and the production of light by electricity." G. ZANNI. Dated Nov. 11. 6d. This consists in constructing dynamo-electric machines with hollow cores in the fixed electro-magnets, which permit of a circulation of water to keep them cool. The armature ring is formed in segments, which can be taken apart or put together readily, giving the advantage of coiling the wire more conveniently. The current for electro-deposition is regulated at will by means of a German silver rheostat with sliding contact.

4590. "Duplex and quadruplex telegraphy." J. MUIRHEAD (communicated by A. Muirhead, J. A. Briggs, and G. Kift Winter, Madras). Dated Nov. 12. 8d. This describes Muirhead and Winter's quadruplex, fully illustrated in the TELEGRAPHIC JOURNAL for July 15.

4595. "Apparatus for generating electric currents, and an improved electric lamp." F. HEINRICHS. Dated Nov. 13. 10d. This describes an alternating and continuous current dynamo-electric machine, with a revolving armature constructed in eight or more sections. Also an electric lamp with circular or spiral carbons. With the circular carbons the arc is formed at their meeting points in the circumference of the circle which they describe. A conducting ring may be inserted between the points as one electrode.

4601. "Telegraph cables." B. HUNT (communicated by M. H. Alberger, and S. W. Pettit, of Philadelphia, U.S.). Dated Nov. 13. 6d. The cable consists of three parts, an outer tube of wrought iron, a conducting wire, with a vitreous insulator between. The wire is introduced into a tube of vitreous material, such as glass; the tube and wire are then introduced into a lap or butt-welded tube of wrought iron; the whole is then subjected to heat, and rolled into a compact whole.

4611. "Producing light, heat, and motive power by electricity." G. EDWARDS, A. NORMANDY. Dated Nov. 13. 4d. An intermittent or alternating current from a machine or battery is divided up among several primary coils, fitted with corresponding secondaries in circuit with the lamps. Light is sometimes produced by decomposing water by the current and directing the gases on a block of lime so as to produce an oxy-hydrogen light. Instead of induction coils, as above, condensers may be used to feed the lamps. (*Not proceeded with.*)

4626. "Electric lighting." St. G. L. FOX. Dated November 14. 8d. Platinised, iridised, or carbonised asbestos is used for electro-pyres, which are enclosed in a globe filled with non-oxydising gas or vapour. Metal spirals are also employed. A carbon pencil floating in mercury against a carbon plate, as in Higgins's lamp, is also described. The subdivision of the current is effected by a main and branch circuits with regulators in them, and also by secondary batteries inserted in the branch circuits as stores. The patent further describes a current meter, in which the current is made by means of electro-magnetism to regulate a flow of air.

4635. "Electric lighting." E. J. C. WELCH. Dated November 15. 2d. This describes a rotating contact distributor in which the current is reversed during each revolution. (*Not proceeded with.*)

4686. "Transmitting electricity to great distances." E. U. PARDO. Dated Nov. 19. 8d. This invention consists in the substitution for cables of a large condenser acting as a reservoir of electricity and extending from point to point. It is charged by means of dynamo-machines driven by waterfalls, &c., and delivers the electricity at any required point throughout

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its length for lighting, heating, motive, or other purposes. The condenser consists of a long glass tube 8 or 10 inches in diameter, coated inside and out with metal-foil, and it is suitably protected and insulated from the ground. The poles of the machine are connected to the coatings.

4689. "Apparatus for producing electric light." E. J. C. WELCH. Dated Nov. 19. 2d. This describes a means of regulating currents by inserting in circuit a metal resistance, which can be varied by a sliding contact moved by the current by means of electro-magnetism. (*Not proceeded with.*)

4690. "Electric regulators, lamps, or candles." J. H. JOHNSON (communicated by A. de Méritens). Dated Nov. 19. 2d. This consists in burning electric candles under a glass dome, having an annular space between the base of dome and the candle. By this means the arc is situated in a space rendered poor in oxygen by combustion, and the carbons are said to last longer. (*Not proceeded with.*)

4693. "Apparatus for dividing electric light." A. RIEMENSCHNEIDER and F. S. CHRISTENSEN, Denmark. Dated Nov. 19. 4d. Each lamp is shunted by a resistance coil, and the expansion of the air round the arc (which is enclosed in a glass tube), is made to regulate the length of the arc by means of its pressure on a piston arrangement. (*Not proceeded with.*)

4696. "Electric telegraph insulators." C. E. CRIGHTON. Dated Nov. 19. 6d. This insulator was illustrated in the TELEGRAPHIC JOURNAL.

4705. "Distributing, regulating, and applying electric currents for lighting," &c. F. J. CHEESBROUGH. Dated Nov. 19. 1s. This describes Sawyer's electric light. See TELEGRAPHIC JOURNAL.

4847. "Electric lamps," in the same names, describes other parts of this apparatus.

4762. "Apparatus for generating and measuring electric currents." J. T. SPRAGUE. Dated Nov. 22. 8d. This describes various improvements in dynamo-electric machines.

4844. "Dynamo-electric machine for producing electric currents." J. L. PULVERMACHER. Dated Nov. 28. 6d. Grooved cylinders or rings of soft iron are set with electro-magnets. They are arranged so as to be concentric, and one is fixedwhile the other revolves.

4873. "Electric telegraphs." Sir C. T. BRIGHT. Dated Nov. 29. 6d. This describes improvements in type printing telegraphs, whereby the letters are printed by inserting different resistances into the line circuit at the sending station. At the receiving a differential relay operates a local circuit which works the type-shaft.

4903. "Magnetic apparatus for curative purposes." R. LONSDALE. Dated Dec. 2. 2d. This describes the coating of strips of magnetised steel or iron with tin, copper, or zinc, and arranging them longitudinally in cloth, so that the N. and S. poles are opposed.

4921. "Electro-deposition of nickel, &c." W. R. LAKE (communicated by E. Weston, of Newark, N.J.). Dated December 2. 4d. This consists in employing boracic acid, or compounds of boracic acid, in the nickel solution. Borate of nickel with other salts of nickel gives a tough and regular deposit of the metal. It also claims the manufacture of solid nickel cutlery, pens, &c.

4960. "Apparatus for generating electric currents, and for producing electric light." (Communicated by the Weston Dynamo-electric Company.) Dated Dec. 4. 10d. This describes a mode of converting an ordinary dynamo-electric machine into a multiple-circuit machine without adding any commutator to it. Also an electric torch formed of two vertical side-by-side carbon rods, with a refractory cylinder of lime, glass, &c., volatilised by the arc. Also a carbon igniter inserted between the points to establish the arc.

4961. "Magnetic appliances for curative purposes." HERBERT COOMBES BYSHE. Dated December 4. 2d. Coating magnets with black oxide of iron by Barff's process, and making double horse-shoe magnets. (*Not proceeded with.*)

4988. "Production of electric light." S. P. THOMPSON, W. P. THOMPSON. Dated Dec. 5. 2d. This consists in forming the rotating armatures of dynamo-electric machines of silver wire instead of copper wire, thereby reducing their size in the ratio of 7 to 10. Also in doing away with or minimising the soft iron core of induction coils by forming the wire of the coil (which is usually copper) of soft iron coated with silver or copper. Also in producing electric light from two platinum or other non-corrodible electrodes with conducting feed to the arc by a rod of carbon inserted between the points, or other means. (*Not proceeded with.*)

5041. "Thermo-electric piles and generators." J M. E. SUDRE. Dated Dec. 9. 6d. This invention was fully described in the TELEGRAPHIC JOURNAL for July 1.

5093. "Apparatus for composing, transmitting, and deciphering secret telegrams." H. J. HADDAN (communicated by Messrs. G. Schacher & Co., Paris). Dated Dec. 12. 2d. This consists in a dial telegraph transmitter and printing receiver. (*Not proceeded with.*)

5136. "Witches for transmitting electrical signals." B. J. B. MILLS (communicated by E. Ganelli, and F. Bardelli, Turin). Dated Dec. 14. 2d. (*Not proceeded with.*)

5181. "Telephones." C. J. WOLLASTON and ADAM SCOTT. Dated Dec. 17. 4d. This describes various means of arranging telephones for speaking purposes. (*Not proceeded with.*)

5183. "Electric Lighting Apparatus." W. R. LAKE (communicated by J. B. Fuller, New York). Dated Dec. 17. 8d.

5255. "Phosphorescent Powders." W. M. BROWN (communicated by J. Peiffer, Colonel W. F. MacCarty, and Prince Talleyrand Perigord de Sagan, Paris). This consists in utilising daylight at night by storing it up in phosphorescent powders and emitting it in the dark. The powders are composed of carbonate and phosphate of lime, calcined Tridacna shells, and cuttle fish bone, sulphur, and colouring matter of mono-sulphur of calcium, varum, &c. The powder is rendered more brilliant by application of electricity. A phosphorescent sea-buoy is also described.

5292. "Telegraph Apparatus." S. PITT (communicated by E. J. Welch, Cambridge, Mass., U.S.). Dated Dec. 27. 1s 10d. This describes a step-by-step type-printing telegraph.

General Science.

LIGHT-GIVING ANIMALS.—In an interesting article on those creatures such as the glow-worm and firefly, which habitually emit light, Prof. Martin Duncan in the *Popular Service Review* shows that the luminosity is neither due to phosphor, or oxidation of the flesh, nor is accompanied by any marked heating effect. In some animals there is no photogenic apparatus; in others it is present as highly refractive cell contents; and in the *Insecta* there are aggregations of these cells into special organs, which are supplied with air-tubes, nerves, and blood. As the light comes from spots about the region where growth, the deposition of fresh protoplasm, and its differentiation into minute granules are in full operation, and as moderatively careful experiment has proved that there is no increase of

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temperature accompanying the light, the cause of it cannot be referred to combustion, to oxidation, or to phosphorus, but to local and then general molecular movement of intense rapidity, which can produce light waves. The phenomenon of self-luminosity in minerals, such as sulphide of barium, is also a consequence of molecular change and motion.

PURIFICATION OF MERCURY.—Herr Brühl gives the following effectual and rapid method for purifying mercury. The impure metal is shaken twice or three times with an equal volume of a solution containing in one litre of water 5 grms. potassium dichromate and a few c.c. of sulphuric acid. The shaking is continued each time until the red mercuric chromate first formed has disappeared and the solution has become pure green in colour. After each operation, the metal is washed in a stream of water sufficiently powerful to carry off a fine green powder which forms on its surface. It is finally washed with distilled water. A large quantity of mercury which has become almost solid from impurities is thus easily purified in the course of an afternoon. The loss of metal is trifling.

SUBSTITUTE FOR LITMUS.—Mr. G. Williams advocates the substitution of ammonium dimethylamidozobenzenesulphonate (the "orange" 3 of Porrier) for litmus in volumetric analysis. It is of an orange colour, and is turned pink by acids. It distinctly shows the presence of 1 part of sulphuric acid in 100,000 of water, whereas litmus ceases to indicate 1 part in 50,000. A great advantage it possesses over litmus is that it is not affected by carbonic acid or sulphuretted hydrogen. The best way to apply the test is, after each addition of acid from the burette, and the contents of the beaker having been well stirred, to allow one drop of the indicator to fall on the surface of the liquid.

ANALYSIS OF CAOUTCHOUC.—According to Mr. D. Lindo, from the analysis of different samples of vulcanised rubber, the percentage of ash varied from 62·7 to 32·07, that of zinc oxide from 60·71 to 15·3, and in three samples the percentage of calcium carbonate was 11·1, 30·29 (mean of three analyses), and 30·44 (mean of two). The action of certain acids on caoutchouc was attended with distension of the material, appearance of small elevations on the surface, and crimping of the edges. These effects are due to the absorption of acid by the material, the solvent action on the mineral matter, and in some cases on the caoutchouc, the softening of the material, whereby the acid enters the pores more readily, and the small elevations are due to surface distension. Sulphuric acid, sp. gr. 1·828, decomposes the material in a few hours; hydrochloric acid, sp. gr. 1·154, turns it red and crimps it; nitric acid, sp. gr. 1·374, decomposes it rapidly. Acetic acid (63 per cent. anhydrous acid) has very little action on pure vulcanised rubber, but, when it contains mineral matter, the latter is quickly dissolved, and the mass becomes distended and crimped.

City Notes.

Old Broad Street, August 12th, 1879.

THE DIRECT UNITED STATES CABLE COMPANY (Limited).—The fourth ordinary general meeting of this Company was held at the City Terminus Hotel, Cannon Street, on Friday, August 1st, 1879, John Pender, Esq., in the chair. The chairman, in moving the adoption of the report, an abstract of which was given in our last issue, said: The expenses, though apparently larger than before, are in reality less. This is caused by the difficulties we have found in getting rid of the great incubus which was fixed on this Company at its formation, and I am afraid that these difficulties are not yet at an end. When the old Direct Company was formed, it was essentially a contractor's company, and for four years they were the only parties who got any benefit out of the Company. The contractors, or those who were more or less connected with them, hung upon the Company till the last moment. The result was that we had an arbitration suit as to the value of the shares, and we thus incurred an enormous waste of money. I believe, in one way and another, with costs, and the difference in the value of the shares, the arbitration cost this Company £21,000. If I were to express an opinion, after the experience of this arbitration, it would be, Have nothing to do with arbitrators or arbitrations, but rather trust to a court of law, and the less of that the better. But, gentlemen, it was not in our option. The arbitration was forced upon us, and I believe even those who forced it upon us would have had as much money in their pockets if the arbitration had not taken place, and they had accepted the amount we offered them for the shares, as they received at the end of the arbitration. Therefore, I consider the amount that was expended through that arbitration was simply thrown away. As I have said, we have not yet got rid of this parasite, which has clung with such tenacity, and has done so much injury to submarine telegraphic enterprise. The parties who were mainly interested in forming the old Direct Company, did so at a cost of something like £300,000 to the shareholders more than it should have cost, and, as I am informed, so rapid was the decline in the value of the shares after the formation of the Company, that even those who had anticipated getting a larger profit out of it, found that it would have been better if they had never touched it. This remark applies more particularly to the syndicate which was formed to float the Company, and sustained a loss of about half a million of money. When I last had the pleasure of addressing you, I referred to a competing company, which was then in the course of formation. The contractors who made the Direct Cable, found it impossible to raise the money in England for another Trans-Atlantic Cable, as the existing company's stock was at 50 per cent. discount; but, showing their usual energy and enterprise, and taking advantage of a period of financial excitement in France, they were fortunate in being able to form another syndicate there, and a company has been floated, with a capital of something like two millions sterling. I need not say that there is a large margin in this sum for the promoters of the company; but I suspect that, before the game is fully played out, this combination will find themselves in much the same position as did the syndicate for the old Direct Company, that is, that their property will be at a discount of 50 per cent. before twelve months have passed over. I am not blind to the fact, however, that to bring about this result it will cost us some money; but we must do our best when we find our property attacked, and attacked in a way which, I must say, is not quite in conformity with a strict business mode of dealing. I think that to go over to France, and take advantage of, I may say to a certain extent, the ignorance of the people, and put before them shares which they could buy in England for half the price they were asking, is scarcely consistent with our idea of fair dealing with the general public, and that at a time when there is no public demand for additional telegraphic communication. It is our duty, therefore, to protect our shareholders, and I trust this will be the last attempt they will be able to make to interfere with Submarine Telegraph Companies.

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When competition is desirable, there is no one who will hail it with more delight than I will. I repeat now, what I said to some of the heads of the financial establishments in France who are carrying out this project: that it was an unfair thing to the French people to invite subscriptions for an enterprise, which, as I have said before, was in England at a great discount. While on this subject I will make a further remark, and that is, that submarine telegraph property is, to say the least of it, a novelty, while it has, at the same time, become a great public necessity. We have yet to learn a great deal about submarine telegraphs: for instance, as to the length of the life of a cable, and, therefore, we ought to be prepared; and I think we have shewn that we are preparing, by the way in which we have accumulated our reserve fund, and will go on accumulating it. Until we know something more of the life of the telegraph cable than we know at present, we must be prudent and cautious in dealing with it. Should telegraphs become discredited in the eyes of the public, and, should the cables fail, and the public be disinclined to subscribe for further cables, the duty to find them must devolve upon the governments. If governments therefore, wish to avoid this great responsibility they must show greater consideration than they have hitherto done for the existing submarine telegraph companies. All the governments acknowledge the great benefits which they have derived, and are deriving, from the companies; but I am afraid they do not take the broad view which they ought to take in regard to their maintenance, for they seem only too ready to grant any one concessions from which they fancy they may receive a temporary benefit, forgetting that such a policy may eventually involve them in serious outlay. I think the result of this new French cable, worked as it is likely to be by the same elements that controlled the old Direct Company will practically have the same result as befel that company, namely, that there will be no dividend for the shareholders for some years, and probably at last it will be rescued from their hands, as the Direct Company was. Before I meet you again, therefore, we may be engaged in active competition—that is, if they succeed in laying a cable. If I were to believe some of the newspaper paragraphs, I should doubt, even now, although a portion of that cable is laid, whether the money has been found for completing it; but I should think that the thing would not be commenced if they did not see a fair prospect of its being completed. Therefore, I assume that it will be completed; and, consequently, the completion of it we must meet. I need only tell you that we are fully prepared to meet that competition, and I think I may say that when we make up our minds to fight we make up our minds to win, and the result I hope will be that the present Atlantic companies will be placed on a sounder and better basis than they have hitherto enjoyed, and that the public will enjoy all the benefits of telegraphy to which they are fairly entitled. When I last had the pleasure of addressing you I mentioned that we proposed to issue debentures at 5 per cent. interest, and that the shareholders would have the first offer. We offered those debentures at 5 per cent., and gave the shareholders the opportunity of taking them up; but there was quite an inadequate response. We have now resolved to make a debenture issue at 6 per cent., as many say to us that other cable companies offer 6 per ent. Preference Shares, such as the Eastern 6 per cent. Preference Shares, and the Globe 6 per cent. Preference Shares. We have decided to adopt a similar rate of interest. I may say that in those companies both those classes of shares are at a premium at the present moment. These debentures we propose to offer to our shareholders at that rate. If the shareholders do not take them up we shall offer any balance to the public. As the proprietors may be aware, our cable has been several times injured on Brown's Bank, a locality where extensive fishing is carried on. Our cables has almost invariably been injured by the fishermen dropping their anchors and hooking it. We have issued a notice which we believe will be largely beneficial to us, to the effect that when fishermen pick up our cable and see that they must either cut it or lose their anchors, we shall, in the latter case, compensate them for their loss; they are put to a certain extent upon their honour in this matter, and I believe the result will be more satisfactory to the company in the future than it has been in the past. Gentlemen, before putting this resolution for the adoption of the report, which I will ask you to approve, I am prepared to receive any remarks which any shareholder may choose to make. The resolution is: "That the report of the directors, dated 18th July, 1879, together with the statement of accounts to the 30th June, 1879, annexed thereto, be received and adopted, and that a final dividend be now declared of 5s. per share, free of income tax, making, with the *interim* dividends already paid, a total dividend of 5 per cent. for the year ending 30th June, 1879." The resolution being seconded, in reply to Mr. Jackson, Mr. Newton, and Mr. John Varley, the chairman said: I am very much disposed to take a similar view to that which Mr. Jackson takes, but, at the same time, I do not think this is quite the time to do it. I think by the time this question of competition is settled, we shall see our way much more clearly than we do at the present time. If we are to fight, I think it as well to have powder for fighting with; therefore, I think it would be better in the meantime to allow the thing to stand as it is; but, if I saw another £100,000 in our reserve fund, I certainly would be very much disposed to recommend the board to adopt Mr. Jackson's suggestion, namely: pay off our debts, reduce our capital, and start with some money in our till. I think Mr. Jackson will probably endorse the view that I take. I approve of the suggestion, and I think, when the proper time comes, that it is a suggestion which will have very great weight with the board. What Mr. Newton says in confirmation is quite right. It is true we have invested in what is only giving us 4 per cent., and we are going to pay 6 per cent. on our debentures, and, therefore the difference is very considerable; but, at the same time, we must be prepared to meet any accident or any break taking place. We must have some money in hand, so as to be prepared to deal with a contingency like that if it is required; but the moment we are safe, that will not be required. I may tell you that in another company, over which I have the honour to preside, what Mr. Jackson has suggested was carried out, and there we wiped off a great deal of debt by applying a certain amount of the reserve fund. Therefore, I may say to Mr. Jackson that, while we are going for this £100,000 on debentures, we are at the same time wiping off a certain amount of shares; on the one hand we are reducing, while we are increasing on the other. Therefore, the difference is not the £6,000 which you point out as interest in this account, because you must pay off the debentures, and the £50,000 which we have paid the dissentient shareholders. We have got their shares, and therefore we hold as against that a very large difference. With regard to Mr. Varley's remarks about the subscription to the Conference, I dare say you are not aware that this Conference is a body of representatives from the different governments of Europe. They meet for the purpose of establishing rules for international telegraphy. Telegraphy has now become so extended that no one country can deal with telegraphy as a section. It is a question that must be dealt with as a whole, and this Conference deals with it

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as a whole. We have not been able, nor is it desirable that we should have any vote at these conferences. We send our delegates, but we send our delegates very much on the principle that is done in America, really to obtain counsel more than anything else, and to make them aware of the submarine telegraph wants, or if there is anything said which might interfere with telegraph property to enable those gentlemen to explain so as to satisfy them that they are imposing on submarine telegraphy rules, which would not be at all in their interest, and which would tend very much to retard submarine telegraph enterprise. The result has been that up to this time at the different Conferences which have been held, I believe the submarine telegraphs have gained immensely in strength from the opinion which is now held by the different governments of Europe in regard to submarine telegraphs. They are treated now as a very important link, in fact, as a great link and they consider them accordingly. When I mention to you that now there is close upon twenty-five millions of money invested in submarine telegraphs, and that is qnite a third of the whole of the cost of land line telegraphs throughout the world, that would give you some idea of the importance of submarine telegraphs. All the different submarine telegraph companies pay an amount so as to enable the companies to receive those delegates and show them attention, and point out to them something of the country in return for the courtesy which was extended to the deputation from this country when they went abroad. I think, after all, that that is money well spent. I am strongly of that opinion. As that is a thing which, as it only comes once in five years, after all it is not a very serious consideration, and I am of opinion that we get very good value for our money. Mr. John Varley: My point is, is it fairly to be expected as the result of this Conference that we shall get the protection for our tariff? The Chairman: Submarine telegraphs are considered as a whole. I think you will see that at the present moment for us to ask the Conference to pass any law which would make our tariffs fixed would be taking the very weapon out of our hands which we intend to wield in the competition we are likely to met with. Therefore, we must not ask that Conference to bind us hard and fast in regard to tariffs. That we will take care of ourselves. We do not want them to interfere with us. We want to make our own tariffs. All we want is, that when we come in connection with those land-lines that we get the full benefit from them of the proportion of the traffic which is passing over those different lines. The resolution for the adoption of the report was then put and carried unanimously.

GLOBE TELEGRAPH AND TRUST COMPANY.—The ordinary general meeting of this company took place on July 31st, at the City Terminus Hotel, under the presidency of Mr. John Pender, M.P—The accounts showed a net revenue for the year, after deduction of expenses, amounting to £160,782 7s. 5d., which, with the balance brought forward, made a total of £161,207 14s. 1d. From this amount there had been distributed in *interim* dividends the sum of £116,625. and the directors had written a further sum of £500 off the preliminary expenses account. The directors recommended payment of a final dividend for the year of 3s. per share on the preference shares and 2s. 6d. per share on the ordinary shares (making, with the former distributions, a total dividend for the year of 6 per cent. upon the preference and 4¼ per cent. upon the ordinary shares), leaving a balance of £973 14s. 1d. to be carried forward. The directors have taken 1800 additional shares of the Eastern Extension Telegraph Company in exchange for an equal number of shares of this company, half preference and half ordinary, thus increasing the holding to 45,719 shares.—In moving the adoption of the report and accounts, the Chairman said the past year's business had been of a satisfactory character, and enabled the company to pay the increased dividends of 6 per cent. upon the preference and 4¼ per cent. on the ordinary shares. In regard to the future, he anticipated the company would derive considerable benefit from the extension of telegraphic communication to the Cape, and by the duplication of the Australian cable, which he trusted would be in good working order by the time they next met. On the other hand, they were threatened with the competition of another Atlantic cable, which was now in course of construction by a French company. He anticipated, however, that the same result would attend that venture as had attended a similar attempt to establish a competing line, viz., that the cable would eventually fall into the hands of one of the existing companies at half price.—Sir D. Gooch, M.P., seconded the motion.—In reply to some observations from shareholders, the Chairman said he held the opinion that submarine cables should be declared to be international property. They were now a great necessity, and Governments could do without them just as little as the general public, and he hoped some day to see the idea realised. In regard to a suggested lowering of tariffs, he believed in fair, reasonable charges. If at 3s. a word they attracted sufficient business to keep a cable employed, any reduction would mean so much loss.—The report was adopted; and the Marquis of Tweeddale and Mr. W. N. Massey, M.P., the retiring directors, having been re-elected, the proceedings terminated.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY, LIMITED.—The half-yearly general meeting of this company was held on August 5th at the City Terminus Hotel, Mr. Henderson in the chair. The report stated that after deducting the usual depreciation on buildings and machinery, the net profit made by the company was £18,800. Of this sum the directors proposed to distribute an *interim* dividend of 10s. per share, being at the rate of 10 per cent. per annum, and to carry forward the balance, £3,200, to be added to the £9,049 brought forward from December, making the balance now to be carried forward £12,249. The paid-up capital of the company was now £312,000, the 3,000 unissued shares having been sold in the open market. The chairman moved the adoption of the report and the declaration of a dividend as recommended, and in doing so he said that the business of the company had been fairly good, perhaps better than they could expect considering the great depression which continued throughout the country. Every article they manufactured had felt the depression, even those the sale of which had hitherto increased during wet weather had been sparingly bought, showing that people had not the money to spend, and were making their old things last longer than usual. In the cable department they had been better employed, and this had to some extent made up for the decline in their general sales. During the past six months the price of india-rubber had advanced, but owing to the foresight of their manager, they held a considerable stock bought at the old prices. Mr. Silver seconded the motion, which was unanimously agreed to.

THE SUBMARINE TELEGRAPH COMPANY.—The report of the directors of this Company to be submitted to the meeting to be held at the City Terminus Hotel, Cannon Street, London, on Wednesday, the 13th day of August, 1879, states the accounts for the six months ending 30th June, 1879, show a result which enables the directors to add the usual proportion of the receipts to the reserve fund, and to recommend a dividend at the rate of 17½ per cent. per annum. The dividend for the corresponding period of the year 1878 was at the

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rate of 17 per cent. per annum. The directors have established, in concert with the German Union Telegraph Company, a duplex system of telegraphy on a wire between London and Emden for the transmission of messages passing over the special wire erected by that Company between Emden and Vienna. The proportion of the cost of the new system is £302 10s. 2d. as charged in the accounts. A Telegraph Conference has just been held in London, at which the delegates of the various States revised the rules and regulations affecting the international service, and agreed to substitute a word-tariff in Europe in place of the present system of charging the same sum for a message containing twenty words, or less than twenty words. All the cables belonging to, and worked by, the Company, are at present in good order. The reserve fund now amounts to £67,564.

THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.—The report of the directors for the half-year ending 30th June, 1879, to be presented at the sixteenth ordinary general meeting of shareholders to be held on the 20th day of August, 1879, states that the gross receipts, including the balance brought from last account, amount to £22,360 14s. 5d., and the gross expenditure to £9,086 1s. 11d., leaving a sum of £13,274 12s. 6d. to the credit of Revenue Account. The above amount of £9,086 1s. 11d. includes, however, the sum of £5,756 1s. 10d., the cost of the repair of the Cienfuegos-Santiago section of the original cable, the ordinary expenses being £3,330 0s. 1d. This repair was completed in March last, but the directors regret to report that the cable again broke down in the end of June, off Turquino. On the recommendation of the Company's engineer in Cuba, Mr. Keith, it has been decided to slightly alter the course of the cable at this point by carrying it out into deeper water, and this will be effected at the same time as the repair, as soon as the cable and stores which are now being got ready arrive. The directors have considered it advisable to place £4,100 to the credit of the Reserve Fund, increasing that fund to £23,011 5s. 0d. The balance of revenue, after providing for the dividend on the preference shares, will admit of a dividend on the ordinary shares at the rate of 6 per cent. per annum, leaving the sum of £1,374 12s. 6d. to be carried forward to the current half-year's account, and they recommend that dividends be declared accordingly, payable 21st proximo. The directors have to report that there has been a falling off in the local traffic, partly attributable to the competition of the Government's land lines and partly to commercial depression. The through traffic, however, continues good, although it was considerably affected during last month and part of the present one, by interruptions on the West India and Panama Company's system.

WE are informed by the Indo-European Telegraph Company that telegraphic communication has been extended to Malacca *via* the Madras-Penang Cable, and messages are accepted by this Company's route from London and the provinces at the rate of 6s. 3d. per word.

THE Anglo-American Telegraph Company's cable laid in 1869, between Brest, St. Pierre, and Duxbury, which was broken in February last off St. Pierre, has been repaired, and is now in good working order throughout. This repair restores direct telegraphic communication between France and the United States.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 52¾-53¼; Ditto, Preferred, 81¼-81¾; Ditto, Deferred, 26-26½; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 7¾-8¼; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 11¼-11¾; Direct United States Cable, Limited, 1877, 10¼-10½; Eastern, Limited, 7⅛-7⅜; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11⅛-12; Eastern Extension, Australasian and China Limited, 7⅞-8; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; German Union Telegraph and Trust, 7⅛-8; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 11-11¼; Great Northern, 8⅜-8⅝; Indo-European, Limited, 21-22; Mediterranean Extension, Limited, 2⅞-3; Mediterranean Extension, 8 per cent. Preference, 9-9½; Reuter's, Limited, 9-10; Submarine, 230-235; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference 7⅞-8; Ditto, ditto, Second Preference, 7⅛-7⅜; Western and Brazilian, Limited, 3-3½; Ditto, 6 per cent. Debentures "A," 94-98, Ditto, ditto, ditto, "B," 87-92; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 118-122; Ditto, 6 per cent. Sterling Bonds, 107-109; Telegraph Construction and Maintenance, Limited, 30¼-30⅝; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2¼-2⅜; India Rubber Co., 12¼-13¼; Ditto, 6 per cent. Debenture, 106-109.

THE SUBMARINE TELEGRAPH COMPANY LIMITED.—Since writing the above notes, the half-yearly ordinary meeting of this Company has been held, Sir James Carmichael presiding. The report of the directors for the half-year ending 30th June last recommended a dividend at the rate of 17½ per cent. per annum, and to add the usual proportion of the receipts to the reserve fund. It also stated the directors had established, in concert with the German Union Telegraph Company, a duplex system of telegraphy on a wire between London and Emden for the transmission of messages passing over the special wire erected by the company between Emden and Vienna.—The Chairman, in moving the adoption of the report, congratulated the shareholders on the balance sheet, which, while showing a slight increase in traffic, did not show a corresponding increase in the expenditure. With regard to the alteration of tariff contemplated, the shareholders were aware that the directors had from the commencement of the company always been advocates of reasonable rates. Many years ago he (the Chairman) endeavoured to obtain a reduction of the present rates from the French Government, and an assimilation of the differential rates from Liverpool, Glasgow, &c., to the Continent. The French Administration did not see their way to meet the wishes of the company. At a late telegraph conference in London there was an almost general expression of opinion in favour of a word tariff. Personally speaking, he would have preferred taking a more medium course, commencing with a ten-word rate. This was advocated by the French delegates, but the general opinion was in favour of a substitution of an actual word rate. Such being the case, it became their duty to endeavour to carry out that intention in the most efficient manner for the interests both of the public and shareholders. He had only just returned from France, where he found that the operation of the word-rate had led to a considerable increase, both in receipts and in the number of messages sent. With an increase of business they must, of course, look to an increase in the expenditure, as a large additional number of messages would mean an increased number of clerks and instruments, and the probable use of the duplex instrument for many of their lines. In any case, they were not likely to require new wires for many years to come, and, when they did, there was an ample reserve fund to supply them from.—Mr. Capper seconded the motion, which was carried unanimously.—After the re-election of the retiring directors and auditors, the meeting closed with the usual compliment to the chairman and directors.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 158.

THE BRITISH ASSOCIATION.

THE forty-ninth annual meeting of the British Association was opened on Wednesday, August 20th, at Sheffield. During the afternoon there was a meeting of the general committee, the retiring president, Mr. W. Spottiswoode, being in the chair, and it was announced that for the future convenience of members that the books belonging to the Association would be henceforth deposited in the library of the University of London, Burlington House. Among other matters there was reference to the efforts made by the Association with a view to the improvement in the Patent Law, efforts which had taken effect in the withdrawal of the new patent bill as it stood; and electricians will be interested to learn that Prof. Hughes is one of the new members of council elected.

The great event of the day was, of course, the address of the new president, Prof. G. J. Allman, M.D., the eminent biologist, which was delivered in the Albert Hall at eight o'clock in the evening, before a distinguished company of ladies and gentlemen. Dr. Allman departed from the usual custom in selecting the topic of his discourse; and, instead of presenting a popular digest of the most conspicuous discoveries of the past year, he confined himself to an exposition of all that is known about the general nature of living matter, and the phenomenon of vitality. For this reason, it will be unnecessary for us to publish his address in its entirety, and we will, therefore, content ourselves with a sketch of its main features.

The physical basis of life is, as is well known, the gelatinous substance, termed protoplasm by Mohl, and sarcode by Dujardin. It is essentially an albumenoid body, and is chemically composed of oxygen, carbon, hydrogen, and nitrogen. In appearance it is a tenacious, "glairy" liquid, resembling the white of a raw egg, and if it be watched under the microscope, it will be seen to be in spontaneous movement. It is the fundamental matter of both animal and vegetable organisms; and is to be met with in probably every part of the world, even at the bottom of the ocean.

"A quantity of a peculiar slimy matter," says Dr. Allman, "was dredged in the North Atlantic by the naturalists of the exploring ship *Porcupine* from a depth of from 5,000 to 25,000 feet. It is described as exhibiting, when examined on the spot, spontaneous movements, and as being obviously endowed with life. Specimens of this, preserved in spirits, were examined by Prof. Huxley, and declared by him to consist of protoplasm, vast masses of which must thus in a living state extend over wide areas of sea bottom. To this wonderful slime Huxley gave the name of *Bathybius Haeckelii*. Bathybius has since been subjected to an exhaustive examination by Professor Haeckel, who arrives at the conviction that the bottom of the open ocean, at depths below 5,000 feet, is covered with an enormous mass of living protoplasm, which lingers there in the simplest and most primitive condition, having as yet acquired no definite form. No law of morphology has as yet exerted itself in this formless slime. Even the simplest individualisation is absent. We have a living mass, but we know not where to draw its boundary lines; it is a living matter, but we can scarcely call it a living being. Other minute lumps of protoplasm found in the fresh waters in the neighbourhood of Jena may be compared to minute detached pieces of Bathybius. Haeckel has seen them multiplying themselves by spontaneous division into two pieces, which, on becoming independent, increase in size, and acquire all the characters of the parent."

Passing on to the next stage in the development of protoplasm, the lecturer described the amœba, which consists of a definite mass of protoplasm having a nucleus imbedded in it. The amœba is an elementary "cell" or unit of life. It feeds, multiplies copies of itself, and moves about spontaneously, playing an important part in the history of the world, for the "ooze" of the Atlantic sea-bed, on which many submarine cables lie, and the chalk of our quarries is the gathered remains of countless amœba skeletons and cases. On rising from this first stage of organisation we find cell added to cell, until many millions of such units become associated in a single organism where each cell, or each group of cells, has its own special work, and all combine to act together for the welfare of the whole.

"The distribution of labour, however, is not a uniform one, and we are not to suppose that the work performed by each cell is but a repetition of that of every other. For the life processes, which are accumulated in the single cell of the unicellular organism, become, in the more complex organism, differentiated, some being intensified and otherwise modified and allocated to special cells, or to special groups of cells, which we call organs, and whose proper duty is now to take charge of the special processes which have been assigned to them. In all this we have a true division of labour—a division of labour, however, by no means absolute; for the processes which are essential to the life of the cell must still continue common to all the cells of the organism."

That there is no essential difference between the protoplasm of plants and that of animals—that, in short, there is no duality of life—is rendered evident by a variety of proof. For example, motor phenomena are not confined to animals, for sensitive plants move spontaneously. In plants, carbonic acid is decomposed in the leaves, which are its lungs, by those cells which contain green granules of chlorophyle, when under the influence of light: and the function of assimilating the carbon is

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relegated to distinct cells which lie deeper in the plant, and are therefore removed from the light; while oxygen is exhaled by the leaves. In animals, we are taught that the process of respiration is the reverse of this, carbon being discharged from the lungs in combination with oxygen as carbonic acid. But we now know that in some of the lower animals, such as the Green Hydra, certain infusoria, planariæ, and worms, chlorophyle is formed in their protoplasm, and, probably, always acts here under the influence of light as it does in plants. On the other hand, it has been shown by Schützenberger that fresh yeast, placed in water, breathes like an aquatic animal, disengaging carbonic acid, and causing the oxygen contained in the water to disappear. Further, it has been shown by Claude Bernard that sensitive plants can be put into a state of anæsthesia by means of chloroform or ether, so as to lose all power of shrinking at the touch, and that germination and fermentation are completely suspended by the same agents. In fine, all recent biological research has brought out more and more clearly that the life of the animal and the life of the plant are in all essential points identical.

We cannot do better than give the remainder of Dr. Allman's extremely interesting address in his own words :—

"I have thus endeavoured to give you, in a few broad outlines, a sketch of the nature and properties of one special modification of matter, which will yield to none other in the interest which attaches to its study, and in the importance of the part allocated to it in the economy of nature. Enough has been said to convince you that, in protoplasm, we find the only form of matter in which life can manifest itself, and that, though the outer conditions of life—heat, air, water, food—may all be present, protoplasm would still be needed, in order that these conditions may be utilised, in order that the energy of lifeless nature may be converted into that of the countless multitudes of animal and vegetable forms which dwell upon the surface of the earth, or people the great depths of its seas. We are thus led to the conception of an essential unity in the two great kingdoms of organic nature—a structural unity, in the fact that every living being has protoplasm as the essential matter of every living element of its structure, and a physiological unity in the universal attribute of irritability which has its seat in this same protoplasm, and is the prime mover of every phenomenon of life. We have seen how little mere form has to do with the essential properties of protoplasm. This may shape itself into cells, and the cells may combine into organs in ever-increasing complexity, and protoplasm force may be thus intensified, and, by the mechanism of organisation, turned to the best possible account; but we must still go back to protoplasm as a naked, formless plasma, if we would find—freed from all non-essential complications—the agent to which has been assigned the duty of building up structure, and of transforming the energy of lifeless matter into that of living. To suppose, however, that all protoplasm is identical where no difference, cognisable by any means at our disposal can be detected, would be an error. Of two particles of protoplasm, between which we may defy all the power of the microscope, all the resources of the laboratory, to detect a difference, one can develope only to a jelly-fish, the other only to a man, and one conclusion alone is here possible—that deep within them there must be a fundamental difference which thus determines their inevitable destiny, but of which we know nothing, and can assert nothing beyond the statement that it must depend on their hidden molecular constitution. In the molecular condition of protoplasm there is probably as much complexity as in the disposition of organs in the most highly differentiated organisms, and between two masses of protoplasm indistinguishable from one another there may be as much molecular difference as there is between the form and arrangement of organs in the most widely separated animals or plants. Herein lies the many-sidedness of protoplasm: herein lies its significance as the basis of all morphological expression, as the agent of all physiological work, while in all this there must be an adaptiveness to purpose as great as any claimed for the most complicated organism. From the facts which have been now brought to your notice there is but one legitimate conclusion—that life is a property of protoplasm. In this assertion there is nothing that need startle us. The essential phenomena of living beings are not so widely separated from the phenomena of lifeless matter as to render it impossible to recognise an analogy between them; for even irritability, the one grand character of all living beings, is not more difficult to be conceived of as a property of matter than the physical phenomena of radial energy. It is quite true that between lifeless and living matter there is a vast difference, a difference greater far than any which can be found between the most diverse manifestations of lifeless matter. Though the refined synthesis of modern chemistry may have succeeded in forming a few principles which until lately had been deemed the proper product of vitality, the fact still remains that no one has ever yet built up one particle of living matter out of lifeless elements—that every living creature, from the simplest dweller on the confines of organisation up to the highest and most complex organism, has its origin in pre-existent living matter—that the protoplasm of to-day is but the continuation of the protoplasm of other ages, handed down to us through periods of indefinable and indeterminable time. Yet with all this, vast as the differences may be, there is nothing which precludes a comparison of the properties of living matter with those of lifeless. When, however, we say that life is a property of protoplasm, we assert as much as we are justified in doing. Here we stand upon the boundary between life in its proper conception, as a group of phenomena having irritability as their common bond, and that other and higher group of phenomena which we designate as consciousness or thought, and which, however intimately connected with those of life, are yet essentially distinct from them. When a thought passes through the mind, it is associated, as we have now abundant reason for believing, with some change in the protoplasm of the cerebral cells. Are we, therefore, justified in regarding thought as a property of the protoplasm of these cells, in the sense in which we regard muscular contraction as a property of the protoplasm of muscle? or is it really a property residing in something far different, but which may yet need for its manifestation the activity of cerebral protoplasm? If we could see any analogy between thought and any one of the admitted phenomena of matter, we should be bound to accept the first of these conclusions as the simplest, and as affording a hypothesis most in accordance with the comprehensiveness of natural laws; but between thought and the physical phenomena of matter there is not only

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no analogy, but there is no conceivable analogy; and the obvious and continuous path which we have hitherto followed up in our reasonings from the phenomena of lifeless matter through those of living matter, here comes suddenly to an end. The chasm between unconscious life and thought is deep and impassable, and no transitional phenomena can be found by which, as by a bridge, we may span it over; for even from irritability, to which, on a superficial view, consciousness may seem related; it is as absolutely distinct as it is from any of the ordinary phenomena of matter. It has been argued that because physiological activity must be a property of every living cell, psychical activity must be equally so, and the language of the metaphysician has been carried into biology, and the 'cell soul' spoken of as a conception inseparable from that of life. That psychical phenomena, however, characterised as they essentially are by consciousness, are not necessarily co-extensive with those of life, there cannot be a doubt. How far back in the scale of life consciousness may exist we have as yet no means of determining, nor is it necessary for our argument that we should. Certain it is that many things, to all appearance the result of volition, are capable of being explained as absolutely unconscious acts; and when the swimming swarm spore of an alga avoids collision, and by a reversal of the stroke of its cilia, backs from an obstacle lying in its course, there is almost certainly in all this nothing but a purely unconscious act. It is but a case in which we find expressed the great law of the adaptation of living beings to the conditions which surround them. The irritability of the protoplasm of the ciliated spore responding to an external stimulus sets in motion a mechanism derived by inheritance from its ancestors, and whose parts are correlated to a common end—the preservation of the individual. But even admitting that every living cell were a conscious and thinking being, are we therefore justified in asserting that its consciousness, like its irritability, is a property of the matter of which it is composed? That consciousness is never manifested except in the presence of cerebral matter, or of something like it, there cannot be a question; but this is a very different thing from its being a property of such matter in the sense in which polarity is a property of the magnet, or irritability of protoplasm. I know that there is a special charm in those broad generalisations which would refer many very different phenomena to a common source. But in this very charm there is undoubtedly a danger and we must be all the more careful lest it should exert an influence in arresting the progress of truth, just as at an earlier period traditional beliefs exerted an authority from which the mind but slowly and with difficulty succeeded in emancipating itself. But have we, it may be asked, made in all this one step forward towards an explanation of the phenomena of consciousness or the discovery of its source? Assuredly not. The power of conceiving of a substance different from that of matter is still beyond the limits of human intelligence, and the physical or objective conditions which are the concomitants of thought are the only ones of which it is possible to know anything, and the only ones whose study is of value. We are not, however, on that account forced to the conclusion that there is nothing in the universe but matter and force. The simplest physical law is absolutely inconceivable by the highest of the brutes, and no one would be justified in assuming that man had already attained the limit of his powers. Whatever may be that mysterious bond which connects organisation with psychical endowments, the one grand fact—a fact of inestimable importance—stands out clear and free from all obscurity and doubt, that from the first dawn of intelligence there is with every advance in organisation a corresponding advance in mind. Mind as well as body is thus travelling onwards through higher and still higher phases; the great law of evolution is shaping the destiny of our race; and though now we may at most but indicate some weak point in the generalisation which would refer consciousness as well as life to a common material source, who can say that in the far off future there may not yet be evolved other and higher faculties from which light may stream in upon the darkness, and reveal to man the great mystery of Thought.

ELECTRICAL SCIENCE AT THE BRITISH ASSOCIATION.

Some New Instruments, recently constructed for the Continuation of Researches on Specific Inductive Capacity.

By J. E. H. GORDON, Asst. Sec. Brit. Assoc.

IN this paper the author illustrated his observations by the exhibition of a miniature five-plate induction balance, similar in principle to the large balance shown at the Dublin meeting of the Association, but intended for the examination of crystals and other precious substances, which cannot be obtained in sufficiently large quantities for the balance; also a gauge for measuring the thickness of the dielectric plates to 1-10,000 inch, and a new form of quadrant electrometer for use with the small induction balance was shown. The capacity of the smaller plates of the little induction balance was so minute, that, when they were attached to the quadrants of the electrometer of ordinary construction (Elliott pattern), disturbances in them produced hardly any effect on the needle, on account of the much greater capacity of the quadrants of the electrometer. In order to construct an electrometer, whose quadrants should have very small capacity, and which should yet be very sensitive, Mr. Gordon had arranged the quadrants as pieces of a flat disc, only one inch in diameter, with the edges bent round them, so that the needle was acted on by both the upper and lower surfaces and the outside edge.

Mr. Gordon also exhibited a new rapid commutator, which was invented by Professor Cornu, of the Ecole Polytechnique, Paris. It could be used with either the large or small induction balance on the one hand, and with a Holtz machine or battery of 500 or more cells on the other. It reverses the electrification of the plates of the balance eighteen times per second, and between each reversal, short circuits, and puts to earth both poles of the induction balance, and both poles of the battery. By altering two screws it can be arranged to short circuit, and put to earth the poles of the induction balance only and to insulate the battery poles.

Secular Changes in the Specific Inductive Capacity of Glass.

By J. E. H. GORDON, Asst. Sec. Brit. Assoc.

The object of this paper was to describe the result of certain experiments made by the author by a method which has already been described before this section. The conclusion arrived at was

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that in the course of a year and a half an actual change had taken place in the glasses, which was shown by a considerable real increase in their specific inductive capacities. To complete our knowledge of this new phenomenon, however, it was considered that a series of monthly observations was required extending over a period of several years. These experiments had some importance as regards Professor Clerk Maxwell's electro-magnetic theory of light. Mr. Gordon had recently suggested that it was quite possible that the relations between electric induction and light exists—namely, that they are disturbances of the same ether, but that there is some unknown disturbing cause affecting the electric induction. Possibly a clue to the nature of this disturbing cause might be found in the fact that the specific inductive capacities were affected by some of the changes which chemists assert are constantly occurring in glasses, but that these changes do not affect the refractive indices.

Electricity as a Motive Power.

By Prof. W. E. AYRTON.

Discourse delivered August 23rd, 1879, to the Working Men of England.

WE hear on all sides new complaints regarding the stagnation of trade, the competition of foreign labour, and the difficulty found in disposing of English products to other countries. Various are the remedies suggested: on the one hand we are told that protection is the cure, because our trade is now almost entirely an import one, kept up by the export of English gold, and not, as it should be, by an exchange of English commodities for foreign ones. Consequently, there are some people who say that the only way to induce other nations to lower their prohibitive import duties, so as to stop this one-sided traffic, is to cause their own goods, now freely exported to Great Britain, to hang on their own hands, and that this can be done by the English temporarily also adopting protection. On the other hand we are assured that emigration is the panacea, and that it is the strikes which ruin the country.

But while the one side is maintaining, and the other side stoutly denying, that commercial depression can be cured by legislation, we are apt, far too apt, to forget that there exists a means by which, without lessening the wage of the workman, or the profit of the master, the cost of production can be diminished, prices lowered, and the failing trade of England resuscitated.

For is it only by burning coals that we can hammer our steel, turn our grindstones, work our lathes, and propel our trains? Coal is no doubt an extremely useful servant, but it is one that here in Yorkshire costs you five shillings a ton when you want to get power out of it, about twelve shillings a ton when used for melting metals and making gas, and about ten shillings a ton when you want it to warm your houses; therefore, as Mr. Bainbridge has been so kind as to ascertain for us that roughly in Sheffield alone about 500,000 tons are used annually for the first purpose; 750,000 tons for the second; 150,000 tons for the third; and 250,000 for the last of these objects, you see there is altogether an annual consumption in this town of about one million six hundred thousand tons, costing you therefore about £790,000 every year.

It is worth while, then, considering whether this consumption of coal can, even in a small degree, be replaced by any other source of power and heat.

For example, at Ottawa, in Canada, where exist perhaps the largest wood-cutting works in the world, the logs of wood come down from the mountains, are collected in the river, lifted and placed in position on the benches, sawn into planks, and stacked; but not a pound of coal is burnt. For merely by taking advantage of the fall of water which exists at the place, a man has merely to turn on a particular water tap to perform any particular operation.

For a stock of water on a hill is, to the people in the valley, what a coal mine is to a Sheffield manufacturer. As the water runs down the hill it can turn wheels, it can work machines just as can coal as it burns in the furnace of a steam engine. You all know the water wheels round Sheffield employed to work the grindstones and the tilting hammers. The high quality of the anvils coming from your Mousehole Forge, where water power is, or was, exclusively used, would be alone sufficient to keep water power permanently before you.

On Goat Island, between the Falls of Niagara, there is a paper works, the machinery of which is worked by the Falls. But what an infinitesimal portion of the energy of these Falls is used by that single paper mill. For, in addition to the gradual slope of the river, on account of which the water acquires considerable velocity, a hundred million tons of water come tumbling down every hour, through a vertical height of 150 feet. Now the power this represents is, of course, the same as would be required by perfect pumps to pump it back again. To raise a hundred million tons of water per hour, through 150 feet, requires the expenditure of nearly seventeen million horse-power; and this could only be produced, with even good steam engines having much above the average efficiency, burning, say 3 lbs. of coal per hour per horse-power, by an annual expenditure of about two hundred million tons of coal, which is about equal to the total consumption of coal throughout the whole world. And if it be remembered that there exist in the world other waterfalls besides Niagara, that we have also innumerable rapidly flowing rivers, the important fact well known to scientific men, but one which it is difficult to induce the world at large to grasp, stares us in the face—that we obtain, in a laborious way from the depths of the earth, the power we employ, and we let run to waste, every hour of our lives, many, many times as much as we use.

But it is not every manufactory that is situated directly over a stream, or even near a stream; and even when that is the case, as in Sheffield, you find streams are sometimes fickle, the tilting cannot be regulated with the same nicety as with a steam hammer—the natural order of things is reversed; water gives way to fire.

But were it possible, without water courses or cumbrous mechanism, to transport direct the energy of the mountain torrent, then machines in the very heart of a town could be worked as economically as those close to cataracts.

Again, even in a perfectly flat country, where waterfalls are unknown, the question of economic transmission of energy has no less interest. For you know that large steam engines can be worked much more economically than small ones. If, for example, I have a steam engine of many hundred horse-power, it can be worked by an expenditure of about two, or two-and-a-half, pounds of coal per horse power per hour, or, at the present price in Sheffield for steam coal, five shillings per ton, the best steam engines, if they be very large, can be worked at considerably less than one farthing

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per hour. But if a man has a small grindstone requiring, say one horse-power to work it, and if he uses a small steam engine for this purpose, then instead of costing him less than twopence per day of eight hours' work, he will probably have to pay a shilling a day, in addition to the expense and trouble of getting up the steam; so that if he only uses the small steam engine occasionally, it will be hardly worth while going to the expense of having one at all. If, however, he could have transmitted to him, just at the time he might require it, a small amount of energy at, say, one halfpenny per hour per horse-power, which would be three or four times the actual cost of production of the horse-power with a very large steam engine, and if he could turn off the power like gas when he did not want it, so that one single hour's work with a one horse power grindstone cost really only one halfpenny, how many of the smaller workmen of Sheffield would be glad to avail themselves of such a facility.

But you will say in our large factories, in our huge cotton spinning mills in Manchester for example, we do use very big steam engines, and therefore this transmission of energy cannot produce any great gain there. Undoubtedly, these steam engines are fairly efficient, because they are so large; but what about the enormous mass of shafting used to connect this single engine with all the stories of the factory and with all the machines in each story? Why, the waste of power in friction in this shafting is so great that, in spite of the extreme inefficiency of small engines, it has been proposed as an economical measure, to replace the one large steam engine by many small ones, each driving two or three machines direct.

It might, at first sight, appear that the water already brought to our houses for drinking and for cleansing purposes, might be also used there for working small turbines or waterwheels, and I have heard this suggested as a possible means of utilising a natural source of power. But this is one of those delusions into which over sanguine people are liable to fall. For there are very few towns where the working pressure of water in the streets is more than able to raise it to a height of 100 feet.

Now 1 cubic foot of water weighs 62½ lbs.
therefore 1 ,, ,, ,, ,, descending 1 ft. per minute does approximately 1 foot pound of work per second.
That is—5½ cubic feet of water per minute } for every 100
Or— 330 ,, ,, ,, ,, ,, hour } feet head
produce approximately 1 horse-power.

Some allowance must, however, be made, for the fact that our best turbines have at the most only an efficiency of 0·8, that is waste 20 per cent. of the power. We may, therefore, say that practically about

450 cubic feet of water per hour } for every 100 feet
Or—2,700 gallons ,, ,, ,, ,, } head
produce 1 horse-power.

But even in places like Sheffield, where the supply of water is large, the minimum cost in the town, when more than seventy millions of gallons are used annually, is not less than 6d. per 1,000 gallons. Consequently, with water at a pressure of 100 feet, it would cost about one shilling and fourpence per horse-power per hour.

In Sheffield, where the working pressure of the water in the lower parts of the town is also unusually high, being not less than 130 lbs. per square inch, or 300 feet head, it would be possible to produce work by small turbines at about fivepence per horse-power per hour, but this of course cannot be compared with less than one farthing per horse-power per hour, the cost of working very large, good, steam engines.

In our poverty and depression, our old servant, coal, is beginning to desert us, and to demand a higher price than we can give. Water, a yet older handmaid, refuses to work at all in our houses, except for extravagant payment. Where is it that we must turn for help? Where can we find the carrier that will, at a small cost, transport our motive power over long distances?

It is to electricity we must look for an answer to this question. It is to that fleet, subtle, messenger to whom we trust the carrying of our news that we must trust the carrying of our motive power.

To explain better what I mean:—When I turn the handle of this machine, my muscular energy is turned into electricity. This electricity is conveyed by the two wires before you to the small motor at the other side of the Hall, where it is converted back again into work. I put in work then here and I get it out again at a distance, without any shafting, straps, or pipes connecting the two places.

In exactly the same way, but on a much larger scale, Mr. Wilson will be so kind as to polish a knife with motive power supplied by Messrs. Walker and Hall, of Howard Street, and conveyed here electrically, by wires suspended to the spire of St. Paul's church, and crossing the streets as you see them in this diagram.

This other diagram shows you exactly how the machines in Howard Street, and these on this platform are electrically connected together.

Now these machines that are employed for this purpose depend on two important discoveries, the first, supposed to have been made by Romanosi, in 1802, who found that an electric current could produce mechanical motion; the second discovery, made by Faraday, in 1831, who, after the most patient investigation, was at length able to prove conclusively the result that he had long felt in his own mind must certainly be true, viz., that a magnet must somehow be able to produce an electric current. The first of these discoveries may be illustrated by the following simple experiment. Here we have a vertical copper wire, through which we can send an electric current either upwards or downwards. Behind the wire there is a magnet, suspended on a horizontal axis, so that it can turn in a vertical plane. The magnet is so arranged, that usually it stands upright, but if I send a current upwards, you observe the marked end turns to your left, while if I reverse the direction of the current, the marked end turns to your right, the magnet in both cases placing itself at right angles to the wire. Now, why does the magnet move when the current flows along the wire? Because the wire with the current in it produces in the space surrounding it the same effect that would be caused by the presence of a large magnet. For if I hold this other magnet in this position, perpendicular to the suspended magnet, you see the latter one turns with its marked end towards your left hand, as it did when the current ascended; and when I reverse the position of the big magnet, the smaller one puts itself in the same position as it did when the current descended. From this you would anticipate that since an electric current can act like a permanent steel magnet, in deflecting a suspended magnet, and since a steel magnet can make this piece of soft wire into a magnet by being put near it, that an electric current will also make a piece of iron into a magnet, a result first proved experimentally by Arago. When the electric current passes through this coil of wire, wound round this iron bar, the bar acquires the power to hold up masses of nails, but the moment the current ceases the iron, as you see, loses almost, but not *quite*, instantaneously, all its magnetic properties, and the nails fall to the ground. But since, by electricity, I am able to produce sufficient pulling force to hold up bits

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of iron, or, at will, cause this force to cease to act, then I must be able to do just as Newcomen did, when he made his so-called atmospheric engine.

For if we cause the attraction of this electro-magnet to pull a piece of iron, or armature as it is called, against the tension of a spring, and if, just when the iron is almost touching the electro-magnet, we interrupt the current, the spring will be able to pull the iron back again, and thus by repeating the action over and over again you see we can get an oscillating motion similar to that obtained in a single acting engine. And any oscillating motion you know can be turned into a rotatory motion by means of a crank and fly-wheel to make the crank pass the dead points. Now, the first man to make an oscillating electro-motor of this kind was a learned monk of Padua Salvator del Negro, in the year 1831. But an oscillating motion has many disadvantages, of which perhaps the most important in an electric engine is that the moving armature at the end of its stroke will be at a distance from the electro-magnet. Now the electro-magnetic attraction diminishes very rapidly as the distance increases, so that when the armature begins to approach the electro-magnet there will be very little force pulling it.

The Russian philosopher Jacobi explained this in 1834, and devised a rotatory engine in which the moving parts were not merely pieces of iron, but electro-magnets like the fixed ones. When the pole of one electro-magnet was approaching that of another due to the rotation of the apparatus, the currents were so arranged that there was attraction, but the moment the moving pole passed the fixed pole the electric current flowing round the former was reversed, so that there was attraction. An instrument such as Jacobi used may be seen working on the table, and like Jacobi's was originally intended to propel a boat. Here again I have a complete model boat driven by an electro-magnetic engine, with galvanic battery in the boat. A third electro-motor is working a Howe's sewing machine, while a fourth is a small engine running round on a pair of metal rails. This last would no doubt pass with the world as a mere toy, but the practical philosopher sees foreshadowed in it his dream of the future, just as Stephenson, in his "Puffing Billy," no doubt foresaw the express locomotive engine of the present day.

But after some time Jacobi abandoned his electro-motor, as the fuel cost far too much. Why then trouble you with considerations regarding electro-motors? Because we have since learnt why the old form was such an expensive producer of power, and what is the proper duty in which electro-motors should be employed.

Now, it was this very question:—Can an electric engine be made to work more economically than a steam engine that first attracted Joule of Manchester, in 1843, to commence that all-important investigation, which lasted for six years, the determination of the mechanical equivalent of heat.

Formerly, electric currents were almost entirely produced only by galvanic batteries, such as I have in my hand, in which zinc is burnt just as in the furnace of a steam engine coke is burnt. The amount of heat that could be got from burning a pound of zinc could be ascertained in the same way as the amount of heat produced by the burning of a pound of coal, but the fact that the latter was about seven times the former was of little value in the science of electro-motors, until Joule had proved that a certain quantity of heat is always equivalent to exactly the same quantity of work, no matter how the heat be produced; in fact, until Joule had arrived at that famous result which, although you know it well, will still bear repeating, that result which made the "Conservation of Energy" a law and not merely a speculation.

A quantity of water on a height, a heated body, a moving mass, two separated quantities of opposite kinds of electricity, an electric current, two chemicals which would combine if brought together, particles of attracting matter at a distance asunder, two planets in space, are examples of energy—each of the systems can be made to do work.

Now, experience shows that all these energies are convertible into heat, and that a certain quantity of each kind of energy is mechanically *exactly* equivalent to a certain quantity of any other. If a body, or if a system of bodies, possesses different kinds of energy, then as long as no energy leaves the system, or enters it from without, this sum is *perfectly constant*, no matter how one of these forms of energy may change into another form. Energy is in fact as indestructible as matter, and this law has one of its proofs in the long unsuccessful search for a perpetual motion.

Since, therefore, a pound of ordinary coal burning gives out seven times as much heat as the burning of a pound of zinc, we may say at once, that a steam engine would give seven times as much work as an electric engine for equal weights consumed, if in both cases all the heat could be turned into work; or, since zinc is about 24 times as dear as coal, that a steam engine would be about 150 times as economical as an electro-motor, worked by a battery.

But so far we have only considered the law of "Conservation of Energy." There is, however, another, and no less important, principle called the "Dissipation of Energy;" and this law tells us that although the energy of a system cannot by itself increase or diminish, yet our power to convert one form of energy into another is continually growing less, our stock of available energy is gradually failing. Our mountain lakes, our vast store of coal is practically useless until either the water is set in motion rolling down the hillside, or until the particles of the coal are set in rapid vibration as it slowly burns; energy of position, energy of chemical affinity, are of no use to the manufacturer until turned into kinetic energy or energy of motion. But from friction of various kinds, whenever energy exists in the kinetic form, some portion of it is being continually converted into heat. Whenever man or nature utilises energy it must be first turned into some kinetic form, and whatever be the aim of the special machinery employed some of this energy passes into heat. We cannot make even a clock go without regular winding up, although the only useful work done by the clock is to turn its hands at regular speeds; the earth's energy of rotation is now, like the moon's in past ages, gradually growing less, and is being converted into heat on account of tidal retardation; the earth, moon and sun, and all the planets are losing their energies of motion and relative positions, to be all ultimately turned into heat.

But at any rate it will be said there will still remain the heat, and since heat can be converted back into other forms of energy, we shall be none the worse off. But it must not be forgotten that whenever heat is produced some passes off by conduction through even our best non-conducting substances, and by radiation into space from even our best non-radiating surfaces; and this conducted and radiated heat, although it may impart some trifling warmth to unseen worlds, is for the greater part entirely lost to our universe. And even were it not so, even had we perfectly non-conducting coatings, and perfectly non-radiating surfaces,—had we, in fact, the most perfect heat engine that our study of the science of heat would lead us to believe theoretically possible, one with no friction, no loss of heat by conduction through the sides of our cylinders, and no radiation from their sur-

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faces—still our power to convert heat into other forms of energy would be very limited. For if there are two bodies one hotter than the other we can employ an engine, like a steam engine, to convert part of the heat in the hotter one into some other form of energy; but the amount of heat converted, with even this ideal perfect engine, will, with such temperatures as are met with in practice, only be a fraction of what necessarily passes through the engine from the hot body to the cold, and warms up the latter; and as our whole power of conversion of heat into work depends on the difference of temperature, we lose it altogether when we have brought all parts of a system to the same temperature, no matter how high this temperature may be.

It is not, therefore, sufficient to say that the burning of a pound of coal produces seven times as much heat as the burning of a pound of zinc; but we must consider what fraction of the heat thus produced is converted into useful work in a heat and in an electric engine respectively.

As already mentioned, our most perfect steam engines can be made to produce one horse-power with the consumption of 2lbs. of coal per hour. Now, the burning of 2lbs. of coal will produce enough energy to raise 18,528,000 pounds one foot, or will produce 18,528,000 foot pounds of work. Now, one horse-power is equivalent to 1,980,000 foot pounds of work per hour, therefore, as regards the total energy in coal, even our best steam engines only utilize $\frac{2}{9}$ of it and waste $\frac{7}{9}$. But, as already mentioned, even a perfect engine cannot, with the ordinary temperature available, utilise the whole of the heat of the fuel. In fact, theory tells us that the efficiency of a perfect heat-engine, or the ratio of the work done on the maximum work obtainable from the consumption of the fuel, is equal to the ratio of number of degrees of temperature through which the steam is cooled in doing work to the highest temperature of our steam, when we take as our zero of temperature a point 460° below the ordinary zero of the Fahrenheit scale.

Now, in our best steam engines, the steam, when it begins to push the piston by expanding, has a temperature of about 300° F. and at the end of the stroke a temperature of 100° F. so that the efficiency of a perfect ideal engine working between these temperatures, is only about $\frac{1}{4}$, not so very much greater than that of best practical engines.

No great advance can be made then in a heat engine, except by making the temperature of the working substance, steam, gas, or whatever it may be, much higher. If, for example, we could raise the temperature of the working substance as high as, say, 3,000° F., the temperature of combustion, and could make it leave the engine without artificial cooling at the ordinary temperature of the air, which is, say, 60° F. then a perfect heat engine, under these conditions, would only waste about $\frac{1}{7}$ of the total energy; consequently assuming that we could, at these high temperatures, make a practical engine as good relatively to an ideal perfect engine, as we can at lower temperatures, then a practical engine would only waste $\frac{7}{25}$ of the total energy, or would have an efficiency of about 0·84.

But, with our present knowledge, to work with steam or gas at a temperature of 3000° F. is almost as ideal as an engine with no friction, and with no loss of heat by conduction and radiation. We are, therefore, led to the conviction that as it is solely by working with steam at very high temperatures, that the efficiency of steam engines can be seriously increased, it may be well to consider whether it is not possible to economically replace the steam engine with some other form of motor.

In order to estimate the efficiency of electric engines, we must consider the discovery made by Faraday, to which I have referred. We know that motion can produce electricity with the ordinary glass electrical machine, and that the electricity so produced can in its turn set up motion, as in the pith ball telegraph worked by Sir Francis Ronalds. We know that difference of temperature can produce an electric current, and the electric current can in its turn produce heat, or difference of temperature. Consequently Faraday felt sure that, since an electric current can, as you have seen, produce a magnet, a magnet must, in some way, be able to create an electric current. But his attempts were baffled time after time; failure, failure only was the result, yet buoyed up with hope, still persevering with that dogged earnestness which is the characteristic of an Englishman, he at length arrived at this all important discovery—to produce a current with a magnet it is no use placing the magnet this way or that way relatively to the coil, but you must have *motion* of the one relatively to the other. And this coil of wire before you is the very one made by Faraday's own hands, and which he used in investigating this problem. The results obtained with it were insignificant in magnitude, but they form the foundation of all the electric lighting of the present day and of the future electric transmission of power.

To enable you to better understand the discovery of "magneto-electric induction," I have here a coil of wire in which a magnet is suspended, and free to move in a vertical plane. Attached to the magnet is a pointer to enable you to detect any motion of the magnet. Those of you who are near will see the pointer itself, while those who are at the other end of the room will see it projected on to the screen as a huge vertical black bar. The exact construction of this instrument is also shown in the large diagram.

Now, we know from our previous experiments that this arrangement will detect whether an electric current is flowing through the wire and also which way it is flowing; in fact the instrument is in principle exactly the same as the one I previously used, only, as the wire goes many times round the magnet in this second instrument, it will detect a much weaker current. To the two ends of the wire forming the current-detector are attached the two ends of the wire forming this coil. The pointer of the detector is now vertical, indicating that no current is passing; but if I rapidly move this magnet towards the coil, the pointer deflects to the left, and then comes back again to the zero position, indicating that an instantaneous electric current was set up in one direction. Now, if I rapidly remove the magnet I have in my hand, you observe the pointer makes a swing towards the right, indicating an instantaneous electric current in the opposite direction. To be quite sure that the deflections you saw produced in the suspended magnet are the results of electric currents, and are not produced by the direct attraction of the large magnet, I hold in my hand, on the suspended magnet, I make a break in the circuit of the wire so that electric currents cannot now flow; and you observe that the motions of the big magnet produce no effect whatever on the little one at this distance.

Now, we have seen that an electric current can do work, and the principle of the conservation of energy tells us that work cannot come out of nothing, therefore, my hand, in moving the magnet, must do as much work as is performed by the current. As this current is weak it would be a little difficult to measure, in a simple way, the work done by my hand; but if we take a machine for producing strong magneto-electric currents, a machine called the "magneto," or "dynamo-electric machine," then as long as the wire is incomplete so that no current can flow, you see it is quite easy for me to turn the handle, but the moment a small

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piece of wire is inserted so that a current is induced, my hand is arrested—I can hardly turn the handle—I have to do work, hard work, in order to continue the motion of the machine, and that work has its equivalent in the electric current that flows, and in the heat which you see the current is producing in the piece of wire we inserted, and which has now become white hot.

But, perhaps you may say, although this is very interesting in connection with the mechanical production of electric currents, what has it to do with the comparison of steam engines with electro-motors, the object of which is not to produce currents, but work? The answer is, because every electro-motor, every instrument that is worked by an electric current, is also a magneto-electric machine, that is, can produce electric currents, and, in addition, always is producing electric currents when it is itself set in motion by one. For taking this simple form of electro-motor—where an iron armature is attracted by an electro magnet—this attraction arises from the fact that as soon as the current is started, the iron armature is first converted by induction into a magnet before it is attracted; consequently when it moves up to the electro magnet, we have the case of a magnet approaching a complete coil of wire, the result of which you now know is the production of an electric current. Now, this electric current must be in the opposite direction to the original current producing the motion, for otherwise the original current would be increased by the induced currents, therefore the armature would be pulled with more force, and the total work done by the original currents would be increased without any equivalent consumption of energy elsewhere. This induced current therefore, like all currents induced by the motion of magnets, relatively to coils of wire, *tends to stop the motion*, and must be taken into account, in calculating the efficiency of an electro-motor; in fact not only must be taken into account, but experiment shows us that it is this tendency of the electro-motor to send a back current that makes it an electro-motor at all.

This reverse current may be thus shown experimentally. I have here a battery sending a current through a Froment's electro-motor, which, as you see, can work either this pump, or this pile-driver. Now, the strength of the current, as measured by this galvanometer, is 40° when I hold the electro-motor at rest, so that it can do no work, and 30° when I allow the motor to move rapidly as you now see it doing.

When an electro-motor is worked by a *given* galvanic battery, then calculations lead us to the result that if we wish to produce the work *most economically* we must, by diminishing the load on the motor, allow its speed to increase until the reverse current it produces is only a little smaller than that sent by the battery; in fact, until the current circulating through the arrangement is very small, in which case the efficiency of the engine, or the ratio of the work it produces in a given time to the maximum work it could produce from the same consumption of material is nearly unity. If, on the other hand, we desire a *given* battery to cause the motor to do work *most quickly*, independently of the consumption of material, then calculation tells us that we ought to put such a load on the motor that its speed will send a reverse current equal to something like a half of the strength of the current the battery could send through the motor when at rest. In this case the efficiency is about $\frac{1}{4}$, or half the energy is wasted in heat.

The difference between these two considerations of maximum values must carefully be borne in mind, especially as it is usually the second—or how to obtain work *most quickly*—that has generally been taken into account, whereas, this evening, it is the other one—or how to transmit work *most economically*—that will specially engage our attention.

Now, let us consider that we work our motor in the most efficient way—that is very fast with a small load, and let us consider that by so doing the efficiency is so little short of unity that we may regard it as one, then since an electro-motor worked by a battery in which zinc is burnt is 150 times as dear as a steam engine for equal efficiencies, the best electro-motor worked by such a battery will be 33 times as dear as our best steam engines having an efficiency of $\frac{2}{9}$. We may, therefore, throw on one side at once all idea of electro-motors worked by ordinary batteries, even although the electro-motors be perfect. Now, this result is most important, since it shows not that an electro-motor as a machine is inefficient, but it tells us that attempting to drive it with a galvanic battery is the hopelessly inefficient part of the arrangement.

But if we turn to the question of using electro-motors for the transference of power, then there is no difficulty about burning zinc, and the high efficiency of such motors is all important.

For in the case of natural sources of power, such as waterfalls, we have merely to consider what amount of energy will be produced at the distant factory; will it be sufficient to repay the expense of putting up wires from the source to the factory, together with the cost of the two dynamo-electric machines, or will it be cheaper to put up and use a small steam engine having probably an efficiency of only $\frac{1}{15}$?

When the distance between the source and the motor is considerable, the cost of putting up the leading wires becomes important, and the question therefore arises, can two or more people use the same leading wires without increasing the thickness, or must the thickness of the wire be so much increased as to make the construction of two sets of leads as economical?

To this question I must beg your most careful attention, since the answer to it, which I hope I may b able to put it in the power of all of you to give, will decide whether the electric transmission of energy is a mere dreamer's fancy, or is likely to have a real commercial future.

In order to decide this let us consider what proportion of the power is lost in transmitting it by electriciity and what is lost when water is used as the carryng, agency. For convenience we will take the second question first.

Let w pounds of water flow per second out of a reservoir, along a pipe into a town, then if there was no friction whatever in the pipe, if the pipe were perfectly smooth so that the water could slip past the surface quite easily, then the work the water could do in the town would be

$$w\ H \text{ foot pounds;}$$

but experience shows that in reality this amount of work, when the pipe is straight, is diminished by at least

$$w\ \frac{4\ f\ l\ v^2}{d \times 64{\cdot}4}$$

where f is a number depending on the smoothness or roughness of the pipe, l the length, and d the diameter of the pipe in feet, and v the velocity of the water in feet per second with which the water flows through the pipe. The work, therefore, that the water can do in the town is only the difference between these two last quantities, or

$$w \left\{ H - \frac{4\ f\ l\ v^2}{d \times 64{\cdot}4} \right\}$$

and the loss goes to slightly heat the pipe and the water. This loss will, in reality, be even greater than

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what I have mentioned, as there is a certain amount of friction where the water enters the pipe at the reservoir, and additional friction at every bend of the pipe.

Now w pounds of water per second flowing, may be enough to work one man's machine, but suppose we want to increase the work done, we must, if we cannot alter the reservoir, diminish the water pressure in the town, to allow the velocity of the water and the quantity flowing per second to become greater. Suppose we double v then w will also be doubled. Double the energy will, therefore, be taken out of the reservoir, but the power furnished in the town will not be twice as great as before, since it would only be twice as great if we could both double the current and keep the pressure in the town constant; the loss, too, of power in the pipe will now be eight times as great as before, so that if we go on supplying a town in this way with motive power, the loss of energy will soon become ruinous.

But there is another way in which theoretically we can increase the power conveyed to the town, and that is by increasing the pressure at the reservoir, as well as the pressure at the town. Suppose, for example, that we double the pressure at the reservoir and increase the pressure at the town sufficiently to keep the difference the same as before, then the velocity of flow and therefore the quantity discharged will remain just the same. The waste, therefore, will not be increased, the power absorbed at the reservoir is double what it was before, while the power given out at the town is more than double what it was before, since the pressure in the town will have to be more than doubled to keep the current constant.

Such an arrangement, as far as we have gone at present, would then be a good one, since if we can much increase the pressure at the reservoir, and use at the town turbines, or water engines, working at a high pressure, we shall be able to transport any amount of power with exceedingly little loss.

Is this then the solution of the problem to transfer power economically by water? Theoretically, yes; practically, no. For when we talk of increasing the pressure at the reservoir, how are we to do it?

We must use some kind of force pump, worked either by a steam engine, having a combined efficiency of perhaps $\frac{1}{10}$ at the most, or by a considerable quantity of the water at a low pressure working a turbine which drives the force pump. Now, the combined efficiency of the pump and turbine will not be more than $\frac{4}{5}$. Taking this latter as being the larger and that assuming at the town itself we have some sort of water-motor, having an efficiency of even as much as 0·8, then the combined efficiency of the whole arrangement cannot be more than 0·32.

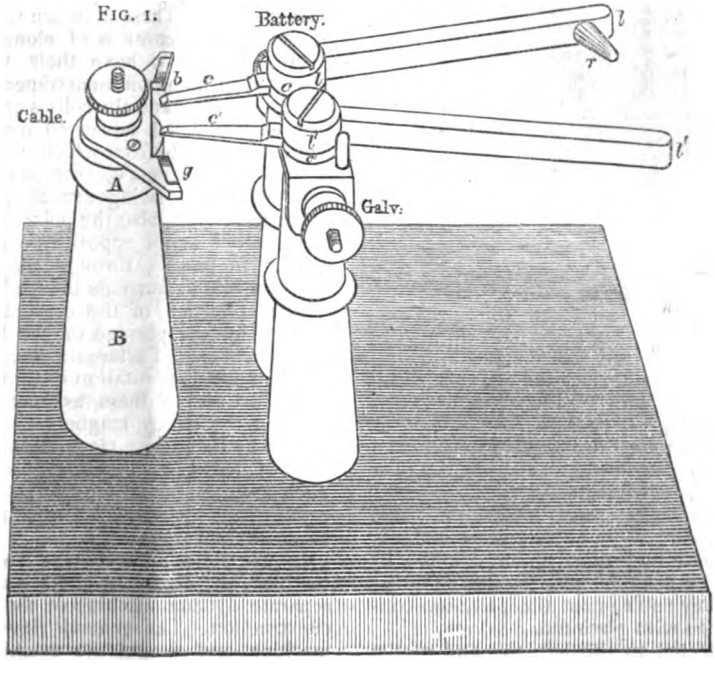
(*To be continued.*)

A NEW FORM OF "DISCHARGE" KEY."

By J. RYMER-JONES.

THE key is so constructed that the *cable terminal* is left perfectly *free* during the period of *insulation* as shown in fig. 1. The leakage from the key is therefore confined to the ebonite support, A B. The form of this support—a vertical section of which is shown in fig. 2—gives a very considerable length of surface, over which any leakage must pass, it being in the present case $6\frac{3}{4}$ inches in a height of only $2\frac{1}{2}$ inches; while since the portion A screws into the outer cap B, the former may be removed, when important tests are about to be made, and rubbed with glass-paper, so as to secure the advantage of a fresh surface without disfiguring the outer

FIG. 1.



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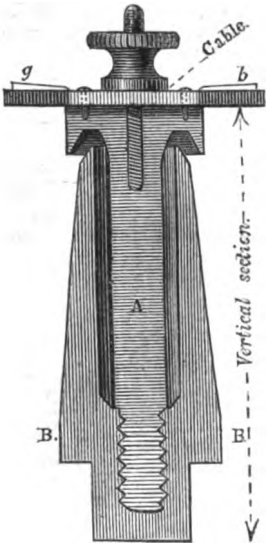
polished surface. Another weak point to be found in the ordinary forms of "trigger" and "cam" discharge keys is that the length of ebonite between the hand and lever connected to the cable, when in the act of *discharging* or *insulating*, is very short, and, moreover, handling cannot but increase the surface conduction, so that the leakage by the body of the operator tends to lower the potential of the charge in a cable. The manner in which the key in question is manipulated entirely prevents this; and a further advantage is obtained by the *rubbing contacts* at *b* and *g*, which are always *firm* and *clean*.

For the above reasons the key is peculiarly well suited for tests where a high degree of insulation is essential, and especially for obtaining exact results when used in connection with a Thomson's electrometer. After A has been freshly sand-papered, and

Fig. 2.



Length of insulating surface 6¼ inches.

before it is screwed into position, a very small quantity of *paraffin oil* may be poured into B, so as to obtain the advantage of a short length of insulating surface which resists the deposition of a film of moisture. The cover form given to the top of A is to prevent dust from entering the cup B.

The movements for "charge," "insulate," and "discharge" will be readily understood from fig. 1. *l l'* are ebonite rods; their brass prolongations *c c'*, which move with them as one piece, have the under surfaces, where they rub against the platinum contacts *b* and *g*, tipped with platinum.

When *l* is deflected to the left, the end of the rod *r*, attached to it, presses against *l'*—should the latter happen to lean towards that side—and carries it over in the same direction, first breaking contact at *c' g*—if previously made—and afterwards making that at *b c*. The cable is thus *charged* by the battery.

To insulate the cable it is only necessary to move *l* back again towards the right, as in fig. 1.

To discharge the cable, press *l'* towards the right. Should *l* not already be over to the right (as in last position for *insulate*) it will be carried over with *l'*, and the contact at *b c* broken before *c'* and *g* come together, so as to discharge the cable through the galvanometer to earth. The rod *r* prevents the galvanometer and battery from both being put to the cable at the same time.

These keys, which have proved highly satisfactory for practical purposes, have been adopted by the India-rubber, Gutta-percha, and Telegraph Company, at their works at Silvertown, London, E., where they are manufactured.

[We have much pleasure in publishing the foregoing description of an instrument which certainly possesses decided advantages, and is therefore likely to commend itself to practical men for cable-testing. —ED. T. J.].

THE SIEMENS-ALTENECK ALTERNATING CURRENT DYNAMO-MACHINE.

THE general construction of this machine is shown by figs. 1 and 2, fig 1 being a longitudinal section, and fig. 2 a front view. On the base A are fixed the two side frames B, carrying each a number of electro-magnets C, C (of which 16 are shown in the drawings), and bearings for the shaft E. On this shaft is fixed a disc J, carrying a number of coils S, of elongated shape, as shown by the dotted lines in fig. 2. These coils are wound in the plane of the disc or cores D of elongated shape. The electro-magnets C have their facing polar ends extended by fixing on them trapezoidal iron plates F, and these plates and the coils S are so proportioned, that each coil has advanced over about half the width of the plate from which it is retreating. The coils of the magnets C, C are so connected that the two polar-fields facing one another are always of opposite polarity, also the polar-fields contiguous to one another are of opposite polarity, and thus the coils S, in passing through the successive fields, have alternating currents induced in them.

The collection of the currents induced in the coils S, by the passage of the latter through the magnetic fields of alternate polarity and the combination and commutation of these currents, and of such portions of them as may be employed for exciting the electro-magnets C, C, is effected in the usual way by contact rings H and the commutator G, provided with tangential contact brushes K, K. Such commutation of the currents through the coils C would be required if the apparatus were used as a direct current machine.

In using the apparatus as an *alternate* current machine, the electro-magnets C, C are excited by a separate dynamo-machine of the ordinary Siemens construction. The general view of this dynamo-machine, and also of the machine just described, which are together capable of burning 16 Jablochkoff candles, are shown by figs. 3 and 4 respectively.

The dynamo-machine, if used separately, will produce a light equal to 1,400 standard candles.

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FIG. 1.

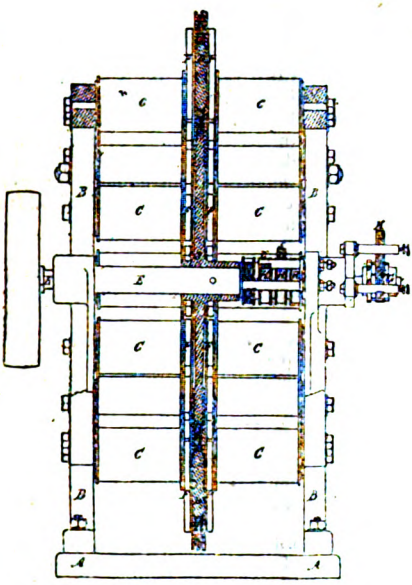


FIG. 2.

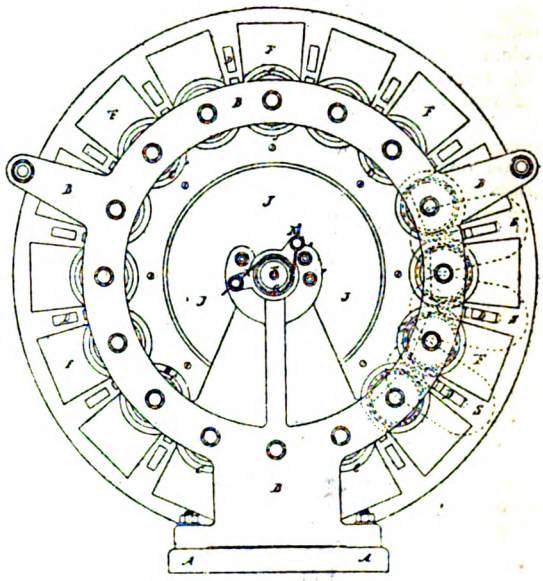


FIG. 3.

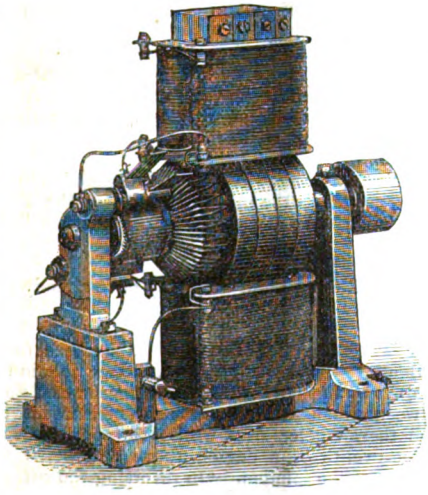
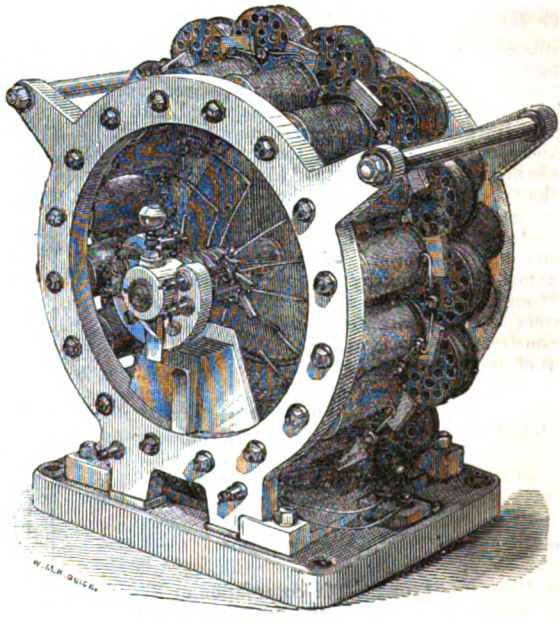


FIG. 4.



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THE POSTAL TELEGRAPH DEPARTMENT.

THE twenty-fifth report of the Postmaster-General on the Post Office for the financial year ending March 31st has just been issued. In the telegraph branch, notwithstanding the continued depression in trade, the number of public messages forwarded during the year shows an increase over the preceding year to the extent of 317,617. The total number of messages forwarded was 24,459,613, and of these 11,240,609 passed through the central telegraph office in London. Nearly 286,000,000 of words of news were delivered in the course of the year to various newspapers, clubs, exchanges, and newsrooms in the United Kingdom. The introduction of the quadruplex apparatus has added another to the fast-speed instruments in use by the Department. Important improvements in apparatus and methods of working have, it is stated, also been effected by the officers of the engineering staff. The process of superseding overhouse by underground wires in London and other large towns has been continued. Up to March 31st, 1879, this change had been carried out in respect of 320 miles of overhouse wire. The private wire business exhibits a satisfactory increase, especially when regard is had to the state of trade, on which it so greatly depends. The revenue from this source stood at £63,305 at the close of the financial year, the number of renters being 1,889.

Correspondence.

A DUPLEX SYSTEM WITHOUT CONDENSERS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Replying to a question by "Indian Telegraph" in your Journal of the 15th inst., you say that *no* duplex system, as far as you are aware, has yet been invented which enabled condensers to be dispensed with when the apparatus comes to be worked on long circuits.

Allow us to inform you that "Theiler's Patent Mechanical Duplex Apparatus" (described in your issue of the 15th June) has been worked with *perfect success* on a line 330 miles long, without any condensers or equivalents to condensers, and with *less* than the ordinary battery power. We are, therefore, supported by actual fact and not by a theory only when we assert most emphatically that a duplex system without condensers *has* been invented, and we shall be happy to demonstrate that fact, on *any* land line, to parties in want of such a system.

Yours truly,
M. THEILER & SONS.

86, Canonbury Road, London,
25th *August*, 1879.

Notes.

THE ELECTRIC LIGHT.—The corporation of Blackpool have arranged to light up the promenade with six of Siemens' electric lights, representing 6,000 candle-power, at a cost of £2,500. The cost is to extend over three years. The light will soon be in operation, and will be kept on for twenty weeks every summer.

A COMPETITIVE trial of the electric light, as supplied by the British Electric Lighting Company, and gas-light, has taken place at the Picton Reading Room, Liverpool, and resulted in favour of the former. The cost of the electric light proved to be one-third of gas; and it is expected that money will be saved in binding, by its use, for gas fumes destroy leather.

REYNIER'S ELECTRIC LAMP.—In a report to the *Société d'Encouragement pour l'Industrie Nationale* of France, Count du Moncel states, that M. Reynier can light five of his incandescent lamps with the current from thirty Bunsen elements; and that he can keep one lamp lit for over a quarter of an hour with three of Plantés polarization cells. He further recommends the lamp to the attention of the Society.

TOMMASI'S ELECTRIC LIGHT.—The French marquis, Tommasi, the inventor of the electro-magnetic relay for submarine cable working, has designed a domestic system of electric lighting, by means of Bunsen's cells. The cells are rendered innoxious by the porous vases being hermetically closed; the nitric acid being fed to the cells from reservoirs filled periodically, by aid of a syphon arrangement. Acidulated water is delivered to the exterior vessels by means of syphons also; and the zincs are self-amalgamating. On the strength of these devices for maintaining constancy, M. Tommasi calls his battery the *pile perpetuelle*.

The lamp is composed chiefly of an iron pipe about three centimetres in diameter, turning on a pivot, and containing five carbons of thirty centimetres length, which, one after the other, in rotation, enter into contact with a disc of carbon forming the negative pole, and thus produce a light during eight or ten hours. The rods are pushed toward the disc by the buoyant power of mercury, and are said to yield a very steady light. The whole size of the lamp does not exceed that of an ordinary Carcel burner. It has been tried in Paris at several places with success. The cost of an apparatus, including lamp and fifteen Bunsen elements, capable of giving a light equal to thirty-six candles, or six gas jets, is 500 francs (£20). The consumption of nitric acid is about one litre a day (requiring two litres of water); and that of carbon is from fifteen to twenty centimetres per hour.

JABLOCHKOFF'S electric light has been installed on the quay of Blankenberghe (Belgium); at the Alpine hotel de l'Engadiner Kulm, St. Moritz, Switzerland; and at the Hotel du Parc, Luchon.

RAPIEFF'S electric light has now been extended to the composing as well as the printing rooms of the *Times* office. It will also be introduced into a Russian light-house.

THE Brush Electric Light Company have already sold over 500 lights for actual use.

TEMPERATURE OF ELECTRODES.—It has been found by M. Bouty that when sulphate of copper solution is decomposed by the current from one Bunsen cell, flowing between metalised thermometers as electrodes, the negative thermometer rises whilst the positive falls about one-twelfth of a degree above and below the temperature of the solution. On reversing the current, the thermal effect is reversed also.

A WIRE CONTACT BREAKER.—Dr. F. Niemoller constructs a simple and rapid contact breaker by stretching an iron wire horizontally and attaching to it a platinum point which touches a mercury surface.

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The current is passed through the wire and mercury, and also through a small electro-magnet placed over the wire. The magnet attracts the wire below as an armature and thus breaks contact with the mercury. The circuit being broken, the current ceases to flow and the wire swings back to its old position, carrying the point into contact with the mercury again. This re-establishes the current, and again the contact is broken. By varying the tension and length of the wire, the number of vibrations per second can be altered: as many as 1,000 breaks per second being obtainable.

MAGNETISING FLUID CAST-IRON.—Mr. E. Chernoff has magnetised a bar of molten pig-iron by surrounding the mould in which it was cast by an electro-magnetic helix. The result was a magnetic bar of cast-iron, having a symmetrical cavity extending about two-thirds of its length, the metal being extremely thin just opposite the centre of the reel. While pouring in the metal, and until it had set, the experimenter noticed a singular agitation in it, and the hollowness of the bar after cooling is supposed to be a result of this disturbance. It is suggested that powerful permanent magnets of cast-iron may be formed in this way by casting under pressure, or in the form of hollow pipes.

THE Lord Mayor has received the cross of the Legion of Honour from our polite neighbours in recognition of his hospitality to the members of the International Telegraph Conference and of the Literary Congress.

THE TELEPHONE COMPANY are about to introduce Bell's telephone into London on the exchange system.

EDISON'S TELEPHONE is also to be introduced into Paris on the exchange system, permission from the Municipal authorities having been obtained.

THE new torpedo ship *Polyphemus* will be fitted with elaborate electric lighting apparatus.

WE hear that Mr. Simpson, who was so successful in asserting his claim to the patent right for application of gutta-percha as a telegraph wire insulator in the United States against the Western Union Company, is possessed with the intention of challenging the cable companies for using that material without his permission. Mr. Simpson is probably inflated with his American triumph; but he had better let that content him.

THE American Union Telegraph Company, the new rival to the Western Union Company, is progressing rapidly with its lines, and expects to open for business on or about the 1st of October.

THE yellow fever epidemic at Memphis, Tennessee, is again causing some mortality amongst telegraphic operators; but not so much as during the plague of last year.

WE are desired by Mr. Johnson, assistant to Mr. Edison, to state that it is not as Mr. Edison's European representative that he has arrived here, but as his engineer. Colonel Gouraud is Edison's only representative in England.

THE PHONEIDOSCOPE of Mr. Edmunds has re-appeared in France under a new name, and been made the subject of a lecture by M. Geraldy, at the Salle des Capucines, Paris. It was exhibited with the Gower telephone, and is reported to be the invention of a M. Coulon, conservator of the Industrial Museum, Paris. Several of our contemporaries, oblivious of the fact that they have recently described it in their pages under another name, are conspicuously hailing its effects as a *transformation of sound into light*. We are riding this transformation of energy hobby so far just now, that a dog howling at the moon will soon be spoken of as an instance of the transformation of moonshine into consciousness.

A SUBTERRANEAN line has been laid from Hamburg to Bremen, Oldenburg, and Emden, with branch lines to Bremerhaven and Wilhelmshaven.

THE lines of the Dominion Telegraph Company of Canada have, we hear, been leased to the American Company for 99 years from the first of July ult., and should the lessees in any way fail to carry out their agreement to pay over quarterly dividends, interest on bonds, &c., the Dominion Company at the expiration of 30 days, are empowered to terminate the lease.

A MONUMENT to Arago was recently unveiled at Perpignan.

A SINGULAR case of lightning-stroke occurred lately at Altorf, during the performance of the opera of Lucie. In the malediction scene, a thunderstorm burst and the tenor was suddenly struck down by the discharge, but happily not quite killed.

FEMALE TELEGRAPHISTS.—There are only 81 female clerks employed in the German Imperial Telegraphs, and these are confined to the Duchy of Baden, having been taken over at the transfer to the Government. These are to be gradually superseded by male clerks as vacancies occur. In our own central station there is also a tendency to limit females to the Metropolitan work in London, as males are found to stand the strain of provincial and foreign traffic better.

ATMOSPHERIC ELECTRICITY.—M. Denza has reduced the data of twelve years' readings on the Palmieri and Bohnemberger's electrometers at the Moncalieri observatory, with the following results:—The development of electricity depends on the combined action of the vapour of water and the heat of the sun. In Piedmont there are two diurnal maxima of electrification succeeding the rise and set of the sun by several hours; in winter they are later than in summer. There is a minimum between these corresponding to the passage of the sun across the meridian. The annual maximum is near the end of winter, in February, decreasing to a minimum in September. During summer the electrification oscillates, because of storms. The annual mean follows the period of magnetic variations and solar spots. Before and after storms the potential of the atmosphere is very low, the electrometer marking almost zero. Snow and rain, and in a less degree thick fogs, hoar frost, glazed frost, and the formation of clouds make it increase.

In a calm sky, and especially when heat is united to serenity, there is very little electricity noticeable. South-east winds increase the electricity of the air; but north-winds do so much more feebly. In strong winds the indications are uncertain. During the whole twelve years of the observations negative electrification has been present 50 out of 100 times, at least with snow and rain. Rain and snow in falling pell-mell give either positive or negative electricity. Negative electricity sometimes precedes or follows storms. When the sky is cloudy or clear the electricity is always positive. When it is negative it is due to foreign causes, as for example storms or distant rains, or

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aurora, or formation of clouds, &c. Lastly, the electric tension, under normal conditions of atmosphere, diminishes with the altitude.

ACTION OF LIGHT ON BATTERIES.—It was discovered by Edmund Becquerel that light influenced the electro-motive force of certain batteries; and M. Pellat has recently observed that light affects a Daniell cell in which the copper plate is oxidised, or has a salt on its surface, whereas if the copper is very clean no alteration ensues. Two standard Daniell elements, of which the coppers were coated with verdigris, gave constant electro-motive forces (1·15 volts for the one, and 1·11 volts for the other) during five months when tested in the shade; but when exposed to the sun they lost $\frac{1}{10}$th of their electro-motive force. The loss was very rapid, but it ceased on interposing an opaque screen between the battery and the solar rays.

The phenomenon is not due to a rise of temperature, for immersion of the cells in water at 50° C. produced no sensible effect on its difference of potential. Besides, a red glass screen, which cut off the blue rays, had the same effect on the battery as the opaque screen aforesaid. On the other hand, a vessel containing a solution of celestial blue, allowing only $\frac{1}{4}$th of the heat rays to pass, transmitted $\frac{1}{5}$th of the efficacious rays, thus proving that more refrangible rays are the active ones. Concentration of the sunlight on different parts of the cell has led the author to the conclusion that it is only the altereo copper plate, and sulphate of copper, which is sensitive to light. The luminous action renders these less electro-negative to the zinc.

ACTION OF MOVING MAGNETISM ON STATIC ELECTRICITY.—Prof. Rowland, as is well-known, established the fact that a body charged with static electricity and in motion, acts upon a magnetic needle as does a current. It is upon this discovery that the Perry and Ayrton theory of the earth's terrestrial magnetism is based. The reverse effect has recently been shown by M. Lippmann to the French Academy of Sciences, who finds that the movement of a magnetic field produces on a small body charged with a unit of electricity, a mechanical force equal in amount and direction to the electro-motive force at the same place. It results from this fact that static electricity possesses a proper mechanical inertia which adds itself to that of the body electrified; and M. Lippmann further points out that an electrified body in movement gives rise to a magnetic field whose intensity is proportionate to the speed, and variation of intensity to the acceleration of the body. Contrarily, the variation of a magnetic field produces on an electrified point, a mechanical force equal to the electro-motive force of induction, and consequently proportional to the speed of magnetic variation ratiocinate to the acceleration of the bodies and directed according to the acceleration. But a mechanical force thus directed, and proportional to the acceleration constitutes what is called a *force d'inertie*. The ratio of the force to the acceleration is a quantity which is constant for the same electric charge, but which is not simply proportional to the quantity of electricity. Electric inertia is no new idea, as M. Lippmann seems to think, for it was given out by Sir W. Thomson years ago.

CAPACITY OF VOLTAIC POLARISATION.—In charging a polarisation battery, a certain quantity of electricity is necessary to bring the electro-motive force of the latter the same as that of the source or charging battery. M. Blondlot has recently investigated this subject, with a view to measuring the quantity in question, and he finds that there is no strict proportionality between this quantity and the electro-motive force of polarisation, but there is an approximate proportionality for feeble electro-motive forces. For higher electro-motive forces, the charge increases more rapidly than the polarisation, in such a manner that, if the phenomenon be represented by a curve, having for abscissæ the electro-motive force, and for ordinates the true charges, the curve is convex towards the abscissæ. The capacity of voltaic polarisation may therefore be defined as a function of the electro-motive force, which is represented graphically by the angular co-efficient of the tangent of the curve in question. M. Blondlot further arrives at the law, which may be thus stated:—For a given electrode and a given electrolyte, the initial capacity does not depend on the direction of polarisation.

HERR WESTPFAHL has applied to the authorities at Berlin for permission to construct tramways in that city, on which he proposes to use electricity as motive power.

A NEW THEORY OF THE EARTH'S MAGNETIC POLES.—From a study of the movement of the compass-needle producing declination at London, Mr. B. G. Jenkins, of the Royal Astronomical Society, has become convinced that the various vicissitudes of the needle during the last 300 years can best be explained by the supposition of a strong magnetic pole above the earth's surface, and revolving around the geographic north pole in about 500 years. He finds four magnetic poles, as maintained by Halley and Handsteen, to be necessary to explain satisfactorily all the phenomena of terrestrial magnetism, but he places these not in the earth, but in the atmosphere. These poles he regards as the free ends of as many broad magnetic belts, two extending from the vicinity of the north pole to the equator, the other two coming up from the south pole to meet them, the boreal magnetism of the northern belts uniting with the austral magnetism of the southern belts along the magnetic equator. These bands he believes to revolve at slow and unequal rates round the poles of the earth, producing secular variations. On this hypothesis, the pointing of the south pole of a magnet perpendicularly to the ground in Boothia, as observed by Sir J. Ross, is explained by supposing that it was really repelled by a like pole in the atmosphere overhead. Mr. Jenkins further calculates that the alleged magnetic pole is no longer in Boothia, but in lat. 72°, long. 115°, a point which lies in Prince Edward's Island.

AN ELECTRICAL MAIDEN.—We are getting accustomed to all sorts of electrical curiosities now-a-days, electric drills, stone dressers, harps, signboards, and a hundred other novelties. These are for the most part mechanical, however, and there is something startling, not to say shocking, in the announcement of an electric girl, 19 years old, recently made by a Canadian paper, the Boudon *Advertiser*. She has, it appears, just recovered from a two years' illness, the nature of which the doctors were unable to determine, as there did not seem to be any organic complaint, and has developed such wonderful electrical powers, that she seems to be a perfect battery. A person, unless possessed of the very strongest nerves, cannot shake hands with her, nor can any one place his hand in a pail of water with hers. By joining hands she can send a sharp shock through fifteen or twenty persons in a room, and she possesses all the attraction of a magnet. If she attempts to pick up a knife the blade will jump into her hand, and a paper of needles will hang suspended from one of her fingers. She cannot drop any light article of steel she may pick up. On her entering a room a perceptible influence seizes all others,

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and while some are affected to sleepiness, others are ill and fidgety till they leave. A sleeping babe will wake up with a start at her approach, but with a stroke of her hand she can at once coax it to slumber again. Animals also are subject to her influence, and a pet dog of the household will be for hours at her feet as motionless as in death. Articles which she uses become magnetised. Now, it appears to us that this young lady is valuable, and we marvel that the Americans have not discovered that there is "money in her." It is clear that she cannot fulfil the usual destinies of her sex and become a wife, since no man would have the intrepidity to kiss her. But nature has not, therefore, left her functionless, and if Mr. Edison cannot utilise her as generator for the production of his electric light, she might prove an inestimable treasure in the service of electro-medicine.

ELECTRICITY AND VEGETATION. — M. Grandeau, whose researches on the growth of plants in an electrified atmosphere, we noticed in a recent number, has also found from simultaneous experiments at Nancy and Mettray (Indre-et-Loire) that the fostering effect of the electricity is felt in the flowering and fruition of plants as well as in their growth. Two like tobacco plants were under similar conditions, with the exception that one was placed under a metal cage while the other flourished in the open air. That in the open air exposed to the influence of atmospheric electricity, produced 89 flowers, of which only a few were *epanoui*, and attained a total weight of 1150 grammes; while that screened from the atmospheric electricity only put forth 45 flowers, of which nearly one-third attained a total weight of 860 grammes. Further the free plant flowered earlier than the enclosed one.

Another experiment consisted in rearing three tobacco plants, one in the open air, the second under a cage, and the third under the shade of a *maronnier* tree. The first bore 41 seed capsules, the second 20, and the third 20. The tree here acted as a cage. Plots of maize were also cultivated with and without an electric screen, and the results showed an increase of nearly one-third in the total quantity or grain produced.

LOSS OF CHARGE.—Herr Narr, a German physicist, from experiments made on an electrified body insulated in gas enclosed in a conducting envelope connected to earth, states his result that the loss of charge by the body is due to two distinct processes, the first one of rapid intense outflow, the other of slow and feeble dispersion. The intensity of the former increases with decreasing density of each of the gases (carbonic acid and hydrogen) used, and also on substituting H for the CO_2, the density remaining the same. The difference between the gases decreases with the density. Herr Narr concludes that the condensed layer of gas on the charged conductor behaves as an insulator, not as a conductor.

COMPOSITION OF GASES BY THE ELECTRIC SPARK. —M. Berthelot finds that two volumes of hydrogen mixed with one volume of oxygen will not combine to form water under the influence of a spark from 7 to 8 centimetres long; although in increasing the tension progressively to the point of disruptive discharge water is formed.

SEVERN'S ELECTRICAL TELL-TALE COMPASS.—This ingenious compass, which was recently on view at Lloyd's office, is designed to enable the captain of a ship to *hear* when she is off her true course. It is contained in a small box, is easily shifted about, and is meant for the captain's cabin, or any other convenient place. An adjustment can be made by the person in charge, whereby an allowance to port or starboard (of any angle) can be made within which the vessel may be steered without alarm being given; but, should the vessel exceed the allowance determined upon, the alarm-bell instantly rings, and will continue to sound until the proper course is resumed, or the alarm liberated. The alarm-bell can also be disconnected at will, and the compass used as an ordinary one. It is claimed that coasts, rocks, and shoals may be better guarded against, officers made more attentive, and men more careful in steering by the use of this instrument, and that the vessel's course will be straight. When vessels are riding at anchor in roads or harbours the tell-tale can be set to make known any swinging of the ship by day or night.

AN ELECTRIC WATCH ALARM.—We learn from *Les Mondes* that the Abbé Ivamors Hà de Bruno, professor of mathematics at Turin, has devised a small pocket *reveil*, which can be applied to watches to remind or wake a person at any desired hour. It is patented in several countries, and is constructed by M. de Bayeux, 41, Rue des Blancs-Manteaux, Paris. Price 16 francs.

THE NEW THEORY OF THE EARTH'S MAGNETISM.—It will be remembered that at the meeting of the Physical Society, on June 29th, Mr. H. A. Rowland, Prof. of Physics in the John Hopkin's University, Baltimore, pointed out supposed error in the calculations by which Profs. Ayrton and Perry sought to establish their new theory of terrestrial magnetism. At that time, Prof. Rowland had not seen these calculations in full, so that he could not say exactly where the error occurred; but in the *Philosophical Magazine* for August, he, having at length seen their full working out, is able to point out the mistake, which according to him is in the sign of an exponent, where $+\frac{1}{3}$ should be $-\frac{1}{3}$. According to the correct results the earth in order to account for its magnetism by the new theory, would require to be electrified to a potential of about 41×10^{15} volts., a charge which would be sufficient to produce a spark in atmospheric air of ordinary density of about 6,000,000 miles. "It was," says Prof. Rowland, "this large quantity which caused me to reject the theory; for I saw what an immense effect it would have in planetary perturbation; and I have even imagined to myself the atmosphere flying away, and the lighter bodies on the earth carried away into space by repulsion. And, doubtless, had not Profs. Ayrton and Perry made some mistake in their calculation, by which the force was diminished 16×10^{16} times, they would have feared like results. For according to Thomson's formula, the force would be equal to a pressure outwards of

$$r = \frac{v^2}{8\pi a^2}$$

which amounts to no less than 1,800,000 grammes per square centimetre! or 10,000 kilos. per square inch! Such an electrostatic force as this would undoubtedly tear the earth to pieces, and distribute its fragments to the uttermost parts of the universe. If the moon were electrified to a like potential, the force of repulsion would be greater than the gravitation attraction to the earth, and it would fly off through space. For these reasons I rejected the theory, and now believe that the magnetism of the earth still remains, as before, one of the great mysteries of the universe, toward the solution of which we have not yet made the most distant approach."

But what if the earth's magnetism be the resultant of several causes, and the electrostatic charge of the surface, according to Profs. Perry and Ayrton, one of them?

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New Patents—1879.

3272. "Electric lighting apparatus." W. R. LAKE (communicated by Dr. L. Concornotti). Dated Aug. 13.

3355. "Manufacture of electrodes for the production of electric light." W. MORGAN-BROWN (communicated by P. A. Parlier). Dated August 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.—1878.

5257. "Induction apparatus." J. H. JOHNSON. Dated December 24. 2d. This consists in distributing electric currents for lighting, and other purposes, by means of an electro-magnet coil, inducing currents in other electro-magnets set near. (*Not proceeded with.*)

5313. "Telegraphic recording apparatus." R. K. BOYLE, New York. Dated December 30. 6d. This describes a recorder in which the moving part is a needle inside a hollow coil. The needle is connected to a platinum index which moves from side to side as the needle is deflected by the current; the position of this pointer determines the flow of a succession of induction sparks, which pierce and mark the signals on a running strip of paper.

5321. "Underground telegraph lines." J. S. PIERSON, Brooklyn, New York. Dated December 30. 6d. These lines are formed by grooved boards in which wires are laid, and then covered with bitumen, &c.

1879.

4. "Obtaining writings, &c., for printing, by means of electricity." A. BROWNE (communicated by G. P. L. Beleel and C. H. O. Hallez d'Arroz, Paris). Dated January 1. 6d. This consists in making a stencil of a writing or sketch by means of a metal point discharging induction sparks through the paper to a metal plate beneath. The stencil thus obtained may be transferred to stone by inking a sheet of paper with transfer ink, and placing the stencil thereon, and covering it with a sheet of white paper, and pressing it sufficiently for the ink to pass through the holes in the stencil.

27. "Electric Lighting." B. A. RAWORTH. Dated Jan. 3. 6d. The continuous cleansing of the commutators of dynamo-electric machines from metallic particles is herein effected by means of brush contact to which is imparted a rotary or reciprocating motion. The application of a magnetic alarm to dynamo-electric machines to warn an attendant or stop the machine on the occurrence of any break or decided diminution of the resistance of the circuit is also described. Mercury resistances controlled by electro-magnets are used to regulate the current; and a regulator lamp for the arc is described in which the usual fly is replaced by a copper disc revolving between the poles of an electro-magnet.

58. "Galvanic Cells and Batteries." WENTWORTH ERCK. Dated Jan. 6. 6d. The vessel consists of a long narrow and shallow trough of lead. The sides are lined with the carbon plates and into the narrow space between the carbons the zinc plate is inserted; the space between the zinc and carbons not exceeding $\frac{1}{20}$ inch. Bichromate solution from a reservoir flows in at one end of the trough and out at the other. In a second arrangement the plates take the form of circular discs which are mounted on an axis with a vulcanite washer between and rotated within the solution so as to give a continuous current.

65. "Electric lamps." A. M. CLARK (communicated by Eugene Ducretet, Paris), Dated Jan. 6. 4d. This lamp consists of a modified Werdermann in which the lower carbon pencil is floated in mercury up against the larger upper carbon. (*Not proceeded with.*)

81. "Electric lamps," W. K. HEDGES. Dated Jan. 8. 6d. Two carbons descending as they waste along guide tubes rest their lower ends on a piece of refractory matter and yield the arc between these ends of which the distance apart is regulated by mounting the guide of one carbon on a rocking transverse axis controlled by a spring, which is in turn controlled by an electro-magnet in circuit with the current.

83. "Electric lamps." W. LADD. Dated Jan. 8. 6d. In this lamp the holders of both the upper and lower carbon points have an advancing and receding motion, for the purpose of bringing the points together and retracting them to complete the electric circuit and to produce the light and regulate its intensity. The holder of the lower carbon consists of a tube which is free to slide vertically in guides in a metal framing. This tube is slotted longitudinally to admit within it a portion of the periphery of a grooved pulley, to which is attached a cord that depends therefrom into the tube, and carries at its pendant end a weight that is free to move in the tube. This weight as its cord is wound on to the pulley comes into contact with a stud projecting inwards from the tube and by this means the tubular carbon holder receives a tendency upwards. Surrounding the lower part of this tubular carbon support is a solenoid or coil of copper wire, one end of which is in metallic connection with the frame of the lamp, the other end being in direct connection with the source of electricity.

144. "Electric Lighting." W. MORGAN-BROWN (communicated by Col. W. F. C. McCarty and Baron Raymond, Sellière, Paris). Dated Jan. 13. 6d. The electrodes in the lamp herein described are of carbon, or platinum, &c., composition, and they are inclined at an angle to each other as in Rapieff's lamp. The light is rendered white by inserting in it a piece of pure calcium or a pellet of an alloy of platinum and iridium. Globes for the lamp are formed not of opaque glass but of two concentric spheres of transparent glass with a shell of water between.

178. "Obtaining Light by Electricity." AUGUSTE DE MERITENS. Dated Jan. 15. 2d. Two semi-cylindrical parallel carbons are placed far enough apart to admit a third carbon with parallel sides. The outer carbons are connected in circuit and the middle one is insulated; but its tip is kept incandescent by the arc. (*Not proceeded with.*)

192. "Preventing rapid destruction of the Electrodes used in Electric Lighting." GEORGE REMINGTON. Dated Jan. 16. 2d. This consists in surrounding electrodes with non-oxygenated gas, or steam or liquids are employed to keep them at a temperature below that at which combustion usually takes place. (*Not proceeded with.*)

City Notes.

Old Broad Street, August 26th, 1879.

ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED—The ordinary half-yearly general meeting of the proprietors of this company was held on Friday, August 8, at the City Terminus Hotel, Cannon-street, Viscount Monck, the Chairman, presiding.

The Chairman, in moving the adoption of the report and accounts to the 30th June, said he was glad to state that, notwithstanding the depression which they were

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all aware still, unfortunately, continued in most branches of commercial enterprise, their traffic within the last half-year had been very prosperous. There had been an increase in the half-year at the rate of about £50,000 a year, and they would have found the very pleasant indication of that fact in the addition which the Board had been able to give to the interim dividend —of ¼ per cent. more than they had been in the habit of giving. That, he thought, was a tangible proof—though he did not know that they required to have it given them—of what he had often stated from the chair—that the directors were desirous of distributing among the proprietors every shilling of money they earned, which they believed was not absolutely necessary for maintaining the credit and permanence of the enterprise. So far with regard to the earnings of the past half-year; and he might state that those of their cables which were in working order were working satisfactorily, and were carrying the traffic in as efficient a manner as ever. The cable of 1869, which broke down some time in the spring, was being repaired as rapidly as possible. They had every reason to believe and hope that they would finish the repairs satisfactorily; but the truth was that the exceptional character of the season, which was the continual subject of conversation here, had prevailed also on the other side of the Atlantic, and the fogs were such that it had been almost impossible for the ship to go to sea for a sufficient time to repair the cable; but there had been no failure in the attempt to repair it. So far as they had gone they had been fully successful, and he had very little doubt, if the weather changed, and became what would be satisfactory to them, that they would succeed in the attempt. With regard to the accounts, if they referred to the abstracts that had been furnished for the last two half-years, in compliance with the promise made about a year ago to the shareholders, they would find that the expenditure of this half-year appeared to be about £4,575 larger than that of last half-year; but, on the other hand, there were items in the accounts of this half-year which were less than the corresponding items of last year, and reduced to the apparent balance against them by £2,398, leaving a balance of £2,177 to be accounted for as the increace in the present half-year. There had, however, been certain extraordinary charges in the half-year, which entirely accounted for the increase, and, when he mentioned them, he thought they would say that they were not to be questioned. In the first place, there was an increase in the article of stationery of £200. This might seem a very large increase, but it was entirely owing to the fact that they were obliged to call an extraordinary meeting, and the expenses of sending out circulars and printing amounted to that sum. Then there was £500 for the entertainment of the International Telegraph Conference which had been sitting in London. All the other telegraph companies contributed their share towards the entertainment of those gentlemen, who came to this country from all parts of the world to arrange the international administration of telegraphy. When the conference was held in other capitals our delegates were treated with the greatest possible kindness and hospitality; and he was certain that the shareholders would not have considered it right that their Company should not co-operate with the other companies and with the Post Office department of the Government in receiving those foreign gentlemen when they came to England in a manner worthy of the country. That, then, accounted for £700 of the increase. Under the head of "maintenance of land lines, instruments, and instrument stores," they would see an increase of £1,600, and that was owing to the fact that electrical instruments, like all other human things, wore out, and they had been obliged to send out to foreign stations entirely new sets of instruments, which accounted for the expenditure. That accounted for £2,300 of the nett increase in the half-year; but, in addition to that—and which showed at once that, so far from being a real increase in the expenses of the half-year, there was, in fact, a diminution—there was another item, an extraordinary item, of £1,000 for new buildings at Valentia. Therefore, instead of there being an increase in the half-year, when they came to deduct the economies effected, and these large extraordinary expenses, which were absolutely necessary and inevitable, they found that the expenditure was less, and had been more economical than for the previous one. The reserve fund, or renewal fund, as they were aware, was being increased at the rate of £150,000 a year, and, at the end of this year, would amount to half a million of money. They had applied the duplex system to their cables, and they had found immense benefit from it. He was not quite sure whether the word "duplex" was realised —that they could carry double the amount of traffic, but it allowed them to carry an enormously increased traffic on the same cables they had hitherto been working. He now came to what was really the most important point touched on in the report, and that was the policy of laying another cable next year. With respect to that question, they must remember two things. In the first place, they must endeavour to maintain the position of this Company as the most powerful and the most efficient company for the purpose of telegraphy in this country. In order to do that, he thought they ought never to allow themselves to get below the position of having three cables at their command. Fortunately for the policy which the Board had pursued steadily, they were in a position to realise these views without asking for a single shilling of money from the shareholders or any one else. He had already told them that the reserve fund at the end of this year would amount to half a million of ready money, including the cable in store. In addition to that, they had the shore ends of the cables of 1865 and 1866, which were in perfectly good order, and which, they were all aware, were a very large proportion of the expense of laying down a cable across the Atlantic—the shore ends were, in proportion, the most expensive part of a cable. They could use these shore ends at both sides, and all that they would have to provide was the deep sea-cable, and he believed they could do that for less than the amount at their credit. He did not know whether he had said enough to commend this policy to their judgment. He confessed that he himself thought it was absolutely necessary and desirable that they should adopt it, and that they should keep themselves in the position of a company bound to maintain two cables, but still with the power in reserve of a third cable, in case of any accident or casualty. So much for the policy which they meant to adopt in future with regard to their cables. At their last general meeting, it was proposed to establish a superannuation fund for their officers by an arrangement with an assurance company. The arrangement was that their Company was to pay half of the premium necessary to obtain the superannuation, and that the officers, out of their salaries, were to contribute the other half. He explained the whole system at the last meeting, but a question was raised in the room as to the propriety of taking that step at the moment. He did not think there was any opposition on principle to the project, but the question was raised as to whether that was the proper time for doing the thing, and the Board agreed to postpone the adoption of the system until the next half-yearly meeting, and to issue proxies to the proprietors generally upon that very point, and ask them to give their votes on it. They had adopted that policy, and

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he held in his hand the return made to them in answer to that appeal. In round figures the votes in favour of the project were £1,251,333, and against it £22,328, and, therefore, having taken the course which was suggested at the meeting, and accepted by the Board, they found that the proprietors of the Anglo-American Telegraph Company, by an overwhelming majority, had decided that the proposition of the Board should be adopted. He then moved the resolution for the adoption of the report and accounts. The resolutions having been seconded, and some queries made by several of those present, Mr. Walker asked if the Board had any information as to the probability when the new French cable would be laid, and how the work was going on. The chairman said he believed they were going on as fast as they could. He had no official information on the subject. He was not in amicable relations with them, and they did not confide their secrets to him (laughter). A shareholder asked what the new cable, which the Board proposed to lay, was likely to cost? The chairman said they had no estimate. In fact, they had done nothing except adopt the policy. He then put the resolution for the adoption of the report, and the motion was carried unanimously. Continuing, he submitted a resolution approving the establishment of the endowment assurance fund, and authorising the Board to carry the arrangement into effect, as expressed, or with any modifications which the Board from time to time might require or approve. A director having seconded the motion, the chairman put it in the usual manner, and declared it carried by 24 to 13. The majority of the meeting, therefore, did not take part in the voting.

THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.—The half-yearly meeting of the shareholders of this Company was held August 20th, at the office, 61, Old Broad Street, Mr. T. Hughes, Q.C., in the chair. The Chairman moved the adoption of the report (an abstract of which appeared in the TELEGRAPHIC JOURNAL, of August 15th), and said that in ordinary times telegraph companies looked forward yearly to something like an increase of 10 per cent., but the business of the Company had not increased to the extent of anything like that percentage. There had been a considerable falling off in the traffic owing to the working of the Government lines, and the falling off had amounted to about one-third. Another reason for the falling off was the want of good condition of the West India and Panama Company. Another reason was that they, as well as other companies, had suffered from the depression of trade. At all events, they were enabled to declare a dividend on the ordinary shares at the rate of six per cent., and this he considered would be a satisfactory announcement (hear, hear). Mr. De Mancha seconded the motion, which was, after a short discussion, agreed to. In reply to several questions, the Chairman stated that the line between Para and Demerara would in all probability bring them a great accession of business, and that if the interoceanic canal were constructed their returns would be considerably increased. The report was adopted, the dividend was declared, and after the conclusion of the formal business the proceedings terminated with a vote of thanks to the Chairman and Directors.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 52¾-53¼; Ditto, Preferred, 81¾-82¼; Ditto, Deferred, 26¼-26¾; Brazilian Submarine, Limited, 6¾-7; Cuba, Limited, 7⅞-8¼; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 11¼-11¾; Direct United States Cable, Limited, 1877, 10-10¼; Eastern, Limited, 7¼-8; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11⅛-12⅜; Eastern Extension, Australasian and China Limited, 7¼-8; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, par 1 pm; Ditto, registered, repayable 1900, par 2 pm; German Union Telegraph and Trust, 7⅛-8; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 10⅞-11⅛; Great Northern, 8⅜-8⅝; Indo-European, Limited, 21-22; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9⅝; Reuter's, Limited, 9-10; Submarine, 220-225; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1¼-1½; Ditto, 6 per cent. First Preference 6¾-7¼; Ditto, ditto, Second Preference, 6¾-7¼; Western and Brazilian, Limited, 3-3½; Ditto, 6 per cent. Debentures "A," 94-98, Ditto, ditto, ditto, "B," 87-92; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 118-122; Ditto, 6 per cent. Sterling Bonds, 107-109; Telegraph Construction and Maintenance, Limited, 30½-31; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2¼-2¾; India Rubber Co., 12¼-12¾; Ditto, 6 per cent. Debenture, 103-108.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
July, 1879 ...	49,320	16,299	2,800	913	16,440	35,789	23,411	20,421	... ...	11,733	... ... *	10,697	4,858
July, 1878 ...	43,610	11,759	2,603	812	14,540	34,451	24,927	18,811	... ...	10,706	... ...	... ...	4,420
Increase	5,710	4,540	192	101	1,900	1,338	... ...	1,610	... ...	1,027	... ...	... ...	438
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	1,506	... ...	... ...	... ...	... ...	... ...	... ...

* The Receipts of the West Coast of America Company for May were £1,025, and for June £725.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 159.

TELEPHONE EXCHANGES.

THE remarkable progress of the speaking telephone in America has been until quite recently in very striking contrast with its apparent neglect in the United Kingdom. In America, the country of its birth, it has been eagerly adopted, and telephone exchanges are now established in almost every city of consequence throughout all the States. It is estimated that there are now more than 40,000 telephones in use there. Chicago alone numbers over 2,000 subscribers to the far-speaking system which ramifies that busy centre of trade, and the process of introduction is rapidly being extended to minor towns, and even to remote settlements of the West. In the mining camps of Nevada and Colorado a telephone exchange is a sign of civilisation, almost as essential as a meeting-house or a bar-room.

Nor are these exchanges confined to the precincts of each city; they actually connect town to town, and thus enable the citizens of one town to converse with those of another, that is, if the distance between be not too great. Telephonic communication has, we understand, been successfully maintained during the middle of the day, when the difficulties were at their height, between Philadelphia and New York—a feat which has also been paralleled in England.

On the other hand, although the admirable invention of Professor Bell was received in this country with loud acclaim, and gave rise to a mushroom crop of popular lectures and scientific experiments, it fell quite flat upon the community in a practical sense. The original enthusiasm soon passed away, and a pernicious faith gradually got abroad that the instrument was merely an interesting toy, very amusing to a drawing-room full of ladies, or highly ornamental to the physical cabinet of a philosophical *dilletanti*, but utterly unfitted for serious everyday use. That this belief was erroneous, is amply demonstrated by the extraordinary success of the telephone in America. The characteristic slowness with which the English elect to throw off old habits and take on new ones, the prevalent dullness of trade, and, perhaps, a lack of enterprise on the part of those owning the appliance, have, also, had much to do with the telephonic standstill here. Our Post Office, unlike that of the German Empire, declined to take up the instrument, and Professor Bell was therefore cast upon his own resources. But he is understood to have been otherwise so hampered and retarded in his efforts to improve and introduce the telephone in England, that he was glad to make his escape to America again, where he could work with greater ease and more hope of practical success.

The triumph of the telephone in that country has, however, at length infected England, and telephonic exchanges are now being established in London and other large towns. The Bell Telephone Company have turned their Coleman Street office into a central station for the city; other stations are likely to be opened soon in the metropolis, and other towns, notably Manchester, are arranging to have exchanges. The time appears to be ripe for them, and the city merchants are waking up to the advantages which they offer for expediting their business. Already a considerable number of subscribers have come forward, and the system has got a flourishing start. The terms charged by the Bell Telephone Company from each subscriber are £20 yearly rental, everything being provided and maintained by the company. The Bell telephones employed as receivers are of the best American make, and a transmitter is used in order to give loud as well as distinct utterance. The exchange switch-board, call-bells, and other connections which have proved so efficient in America are also adopted by that company.

The discovery of the microphone by Professor Hughes undoubtedly reduced the value of Mr. Edison's carbon transmitter, which relied for its efficiency on the electro-magnetic telephone as a receiver, and that inventor, with characteristic pluck, thereupon set himself to perfect his electro-chemical receiver and make it fit to take the place of the electro-magnetic receiver, which was at the best borrowed from Prof. Bell or Mr. Elisha Gray. The English public have had many opportunities during the past winter of judging for themselves of his success in this difficult task, and at last a telephonic exchange, on the Edisonian model, has been opened at No. 6, Lombard Street, and a number of subscribers gained.

Mr. Edison employs slender steel wires, electro-typed with copper for his lines, so as to combine lightness, strength and conductivity. They are further covered with a slight coating of insulating material, which insures their insulation and durability in the moist, corrosive atmosphere of London. The electro-chemical telephone is "loud speaking;" but, by a simple mechanical contrivance, it is provided that conversation can be carried on without

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being audible beyond the desired limit. A monthly rental is charged for the use of this system.

Now that the ice is broken, we anticipate that the telephone will be taken up with the customary energy of our countrymen, and we hope soon to see the whole of London, as well as other large cities, divided up into districts, each furnished with its central telephonic station.

ON LIGHTNING PROTECTORS FOR TELEGRAPHIC APPARATUS.

By WM. HENRY PREECE, Electrician, General Post Office.
(Read before the British Association.)

FOR many years it was not the practice in England to protect telegraphic apparatus from the injurious effects of atmospheric electricity because the damage done was so insignificant, and because the remedy was found to be worse than the disease.

But as telegraph systems increased—as the country became enveloped in one vast network of wires, it was found that the damage done became considerable, until, in fact, about 10 per cent. of the apparatus in use were in one year damaged.

Lightning protectors then became essential. Many forms were tried, based on the fact that when a discharge takes place through a non-conductor, such as dry air, at the moment of discharge the resistance along the line of discharge is practically nothing, and, therefore, all the charge is conducted away. According to Faraday, "the ultimate effect is exactly as if a metallic wire had been put into the place of the discharging particles." (*Researches*, series XII., 1406.) Most of those tried failed.

The survival of the fittest has been exemplified in the "plate" protector. In this form—one of the earliest introduced—one thick plate of brass is in connection with the earth, and another similar plate in connection with the line is placed above it, but separated from it by paper, or by insulated washers. The lightning, on entering the wire, bursts across the paper, or air space, in preference to passing through the apparatus, and thus escapes to earth.

An important modification of this plate discharger has been made by Dr. Werner Siemens, who, by serrating, or grooving with a pointed tool the opposing faces of the two plates at right angles to each other, converted them into a conductor, which was supposed to be one composed of an infinite number of opposing points. The remarkable action of points in facilitating discharge is well known, and their introduction into lightning protectors occurred very early in the annals of telegraphy, by Mr. C. V. Walker, F.R.S.

Messrs. Siemens' arrangement, very pretty in theory, never carried conviction of its value in the mind of the author, because protectors, so prepared, never singled themselves out as evidently superior to others that were not so prepared; and while the intersection of the grooves certainly formed mathematical points, they did not form physical or mechanical points, and it is upon the action of this latter kind of point that such remarkable electrical effects are produced.

Dr. Warren de la Rue, having very kindly placed his well known battery of 11,000 cells at the disposal of the writer, he prepared four plate protectors, identical in dimensions, excepting that two were serrated, and two were not. The two plates were separated from each other by narrow ebonite washers ·01 inch thick. The upper plate was placed in connection with the positive pole, and the lower plate with the negative pole. The number of cells were increased until a continuous current of electricity flowed.

1. PLAIN PLATES.

No. of cells.	Effect produced.
1,000 . .	Slight sparks just commencing on completing circuit.
1,080 . .	Sparks evident.
1,200 . .	Sparks frequent and abundant.
1,500 . .	Continuous arc.

2. SERRATED PLATES.

No. of cells.	Effect produced.
1,000 . .	Sparks just commencing on making contact.
1,080 . .	Sparks evident.
1,200 . .	Sparks frequent.
1,500 . .	Continuous arc, but fitful.

2,000 cells in each produced a continuous stream of electricity. The effect with 1,500 cells was decidedly more marked with the plain plates than with those serrated. The experiments were extremely pretty, and very decided in their character.

Hence it appears that grooving is not only of no use, but that it rather deteriorates the value of the protector.

These experiments confirm very decidedly the accuracy of the figures obtained by Dr. Warren de la Rue and Mr. Müller on the striking distance between two flat discs given by them in their paper read before the Royal Society (*Phil. Trans.*, vol. 169 : 77), where it was shown that 1,200 cells struck across ·012 inch. Here 1,000 cells struck across ·01 inch, which agrees perfectly with the curve produced by those observers.

It is the practice in the Post Office Telegraph Department to keep these plates apart by thin paraffined paper ·002 inch thick, so that the air space is really much thinner than that experimented upon, and the striking difference of potential only 250 volts.

Messrs. de la Rue and Müller have shown that for points and various kinds of surfaces opposed to each other, plain surfaces act the best for potentials less than 1,500 volts., and that points are only efficient for high potentials. Now, as it is doubtful whether atmospheric electricity causes much higher potentials in telegraph wires than 1,000 volts., it is clear that plain surfaces are the most effective for protecting apparatus. It is quite certain that such plates, plain and smooth, separated by an air space ·002 inch thick, will form very efficient lightning protectors.

The author is very much indebted to Dr. Warren de la Rue for the performance of the experiments in his laboratory.

August, 1879.

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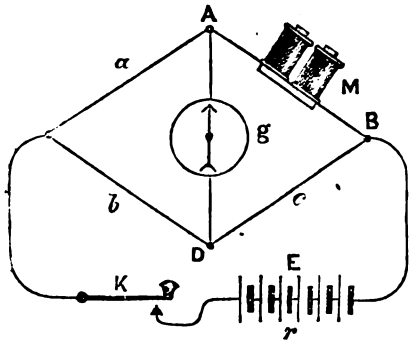
A METHOD OF MEASURING ELECTRO-MAGNETIC DISCHARGES.

By H. R. KEMPE.

IT is sometimes required to compare the relative electro-magnetic discharges obtained from electro-magnets used in telegraph instruments. To do this the electro-magnet has been treated as a condenser, and the discharge measured by the well-known method with an ordinary discharge key. This arrangement is, however, a very unsatisfactory one, and does not give good results; it is very necessary that the adjustments of the key be made so that the contacts are very close together, otherwise a great portion of the charge is lost during the interval which elapses while the lever of the key is moving from the battery to the galvanometer contact, and even when the contacts are very close and the movement of the lever is very rapid, a portion of the charge is almost certain to be lost. The following arrangement for making the measurements I have found to answer very satisfactorily.



The magnet whose discharge is to be measured is placed in one of the arms of a Wheatstone bridge, and the key K being kept depressed balance is obtained on the galvanometer by adjusting c in the ordinary manner. When this is done, in order to obtain the discharge we have simply to release the key K, and the battery being thus taken off, the magnet immediately sends its *whole* discharge through the galvanometer and other resistances. If we wish to compare the relative discharges obtained from several magnets, we should first note the discharge deflection obtained from the electro-magnet with the highest resistance, and then the discharges from the other electro-magnets, inserting in the arm of the bridge along with them in each case a resistance sufficient to bring the total resistance in that arm equal to what it was when the first magnet was being tested. By doing this the currents exciting the electro-magnets in each case will be the same, and their discharges will consequently be directly comparable.

In order to obtain generally comparable results, we must know the current strength exciting the electro-magnet and the resistance through which the discharge takes place; then the value of the discharge deflection, in terms of the discharge deflection obtained from a condenser of a known capacity charged to a definite potential, will give us all that we require.

To obtain the current strength C exciting the electro-magnet, we have, since no current passes through the galvanometer,

$$C = \frac{E}{r + \frac{(M+a)(b+c)}{M+a+b+c}} \times \frac{b+c}{M+a+b+c} = \frac{E(b+c)}{r(M+a+b+c)+(M+a)(b+c)}$$

and since $a c = M b$, or $c = M\frac{b}{a}$, we get

$$C = \frac{E\left(b + M\frac{b}{a}\right)}{r\left(M+a+b+M\frac{b}{a}\right)+(M+a)\left(b+M\frac{b}{a}\right)} = \frac{E b}{r(a+b)+b(M+a)}$$

where E is the electro-motive force of the battery.

The resistance R, through which the discharge takes place, will be

$$R = M + c + \frac{g(a+b)}{g+a+b} = M + M\frac{b}{a} + \frac{g(a+b)}{g+a+b} = (a+b)\left[\frac{M}{a} + \frac{g}{g+a+b}\right]$$

If d be the discharge observed in the galvanometer, then the value of the discharge D obtained from the electro-magnet will be

$$D = d \times \frac{g+a+b}{a+b}$$

This quantity (D), compared with the discharge obtained on the same galvanometer from the condenser charged from a standard electro-motive force, a Daniell cell for example, gives the means of comparison required.

This method of measuring a discharge may be applied with very great advantage to the tests for "localising a complete fracture," and for "localising a partial disconnection" in submarine cables, described in the numbers of this Journal for April 1st, 1876, and February 1st, 1878, respectively. In each of these cases the cable would be connected to the point A, whilst the point B would be put to earth. Then when balance is obtained, $\frac{a c}{b}$ gives the resistance of the cable, and the throw on the galvanometer when the key is raised gives the discharge, the value of which has to be multiplied by

$$\frac{g+a+b}{a+b}$$

The discharge from the cable takes place, of course, through a resistance

$$\frac{g(a+b)}{g+a+b} + c$$

which has to be inserted in the place of G in the formulæ given in the articles referred to.

The great advantage of this system, irrespective of the most important point that it allows none of the discharge to be lost, lies in the fact that the discharge will be measured at the very moment when the resistance is known, for the discharge will not be taken till the needle is at zero, and at that moment, as has been pointed out, the resistance equals $\frac{a c}{b}$.

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ELECTRICAL SCIENCE AT THE BRITISH ASSOCIATION.

Electricity as a Motive Power.

By Prof. W. E. AYRTON.

Discourse delivered August 23rd, 1879, to the Working Men of England.

(Continued from page 283.)

Again, although we have only a small flow of water, so that little of the energy will be lost from friction, the pipes must be made extremely strong to bear the great pressure, and consequently must be expensive, also it will be extremely difficult to prevent contraction and expansion of the pipes starting leaks at the joints. Now, with the water at a very great pressure, and with a very slow flow along the pipe, a very little leakage will represent a large percentage loss of energy.

Although, therefore, as far as friction in the pipes only is concerned, a very high pressure at the reservoir, combined with the use of turbines in the town, working at a high pressure, furnishes a very economical mode of transmitting power, it is quite impracticable except for short distances.

Now, the conditions for economically transmitting power by electricity are, as we shall see, *identically* the same as those we have arrived at for the transmission by water in pipes, but luckily they are not in the electrical case by any means impracticable.

In any generator of electricity there is a certain property called the electro-motive force, which means its tendency to send a current and which is analogous with the head of water in a reservoir, inasmuch as the product of the quantity of electricity flowing per second, multiplied by this electro-motive force, measures the amount of energy furnished by the generator per second, and which could be reproduced as motive power elsewhere if there were no friction. Now, the loss of energy due to electrical friction in the wires is equal to the square of the current flowing per second multiplied by what is called the resistance of the wire, a number depending on the length, the diameter of the wire, the material of which it is made, and the temperature.

Now, I explained to you that when an electro-motor was working it produced a back electro-motive force tending to diminish the current. The maximum work that can be given out by this electro-motor per second, if its efficiency is unity, that is, if there is no friction or other loss of power, is equal to the product of the current into this back electro-motive force. There are two ways, therefore, of altering the work given out by the electro-motor per second. Either we may increase the current, or we may increase this back electro-motive force. Let us consider the first case: we will double the current; then assuming that the electro-motive force of the generator remains the same, which in the water question is equivalent to assuming the height of the reservoir above the town constant, we should have to let the electro-motor run at such a diminished speed that the difference between the electro-motive force of the generator and the back electro-motive force of the electro-motor is double what it was before. Although, therefore, we have doubled the current, and the energy furnished by the generator, we have not nearly doubled the energy given out by the motor, and the reason of this is obvious, since as the waste of power in the production of heat in the wires is proportional to the square of the current, four times as much power will be wasted as in the previous case.

Consequently, just as in the case of water, increasing the current is a ruinous way of increasing the transference of energy.

Now, take the other case: assume that we double the electro-motive force of the generator, and run the motor at such an increased speed that the current remains constant; to do this we must more than double the back electro-motive force of the motor. The energy now furnished by the motor will be double what it was before, the energy given out by the motor will be more than double what it was before, and the energy wasted in heat will be exactly the same as before.

Consequentiy, just as we concluded in the case of the water, that the most efficient method to employ in order to transfer the energy, was great pressure in the reservoir, combined with turbines in the town working at a high pressure, so now we conclude that the most efficient way to transfer energy electrically is to use a generator producing a high electro-motive force, and a motor producing a return high electro-motive force; and by so doing the waste of power in the transmission ought, I consider, to be able to be diminished with our best existing dynamo-electric machines to about thirty per cent; for, as experiment shows the efficiency of our best existing dynamo machines to be 0·86 (that is 86 per cent. of the power spent in revolving the bobbins is reproduced as energy of electric current); therefore, if two similar dynamo-electric machines be coupled up to transmit power, and if they are worked most *economically* in the general way I have already explained, and with the details of arrangement that I will enter into later on, instead of being worked so that the motor gives out power *most rapidly*, I have reason for expecting that the combined efficiency of the arrangement can be made to closely approach the square of 0·86, and not merely one-half, as commonly supposed.

But while the two solutions of the problem are thus identical, there is this most important difference: increasing the pressure of the water means an uneconomical task, while increasing the electro-motive force set up by a dynamo-electric machine, or an electro-motor, means merely running it faster, or running it at the same speed and putting more wire on the rotatory portion.

And again, assuming that the mean electro-motive force between the wire and the earth be as much as one hundred times the electro-motive force producing the current, namely, the difference between the electro-motive forces of the generator and of the motor, then with the ordinary insulation of the best land telegraph lines, less than one per cent. of the energy transmitted ten miles would be lost by leakage.

It would be impossible to increase indefinitely the speed of revolution of the cylinder of an induction machine, since apart from mere mechanical friction the iron constituting the core of the revolving part has to be magnetised and demagnetised very rapidly as it revolves. Now, there is a physical limit to the speed with which this can be done, and in addition this rapid change of magnetism heats the iron very much. But experiment shows that at the ordinary speed of revolution of dynamo-electro machines, 700 turns per minute, the electro-motive force is proportional to the speed. We are, therefore, very far yet from the limit of speed. Consequently it would be well for the transmission of power to attempt first, a considerable increase of speed in the generator, combined with so light a load on the motor, that its speed is also very high. When this begins to fail as larger and larger amounts of power are transmitted, then we might begin increasing the amount of wire on the revolving coils of each; but this, of course, has the objection that the loss

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of power from a given current would then become somewhat larger.

In some of the dynamo-electric machines, the current that is sent through the external wires is the same as that which circulates round the fixed electro-magnets to create the magnetic field in which the movable coils revolve. Now, the small current which I am here advocating should pass between the generator at the one end of the line, and the electro-motor at the other, would be too small to properly magnetise the fixed electro-magnets of the two machines, so that even a high speed of the bobbin will not produce a high electro-motive force. But this diffiulty is easily overcome by the plan already employed, for totally different reasons, by Gramme, Lontin, and Wilde, in their generator for producing currents for electric lighting, viz., that of using either a separate exciter, or a separate portion of the revolving bobbin in the generator, to produce the current to magnetise the fixed electro-magnets. In connection with this current for exciting the fixed magnets, it is worthy of notice in passing, to observe that since experience shows that the electro-motive force of a dynamo-electric machine is proportional to the velocity, I conclude that the magnets are saturated, and that the exciting current is already too strong, so that it may be with advantage reduced, or many fewer coils of wire employed in this portion of the machine.

We have then been led to this most important result, which I hope is clear to you all, and which I trust you may all carry away with you,—*that a dynamo-electric machine, with a separate exciter, driven very fast with a steam engine, or with a stream of water, at high or low pressure, and sending by even quite a fine wire a small current to a distant electro-motor, also running very fast and magnetised by a separate exciter, is an economic arrangement for the transmission of power.*

We have seen then how to transmit electrically any amount of power through a fine wire. Now, how is this result affected by increasing the distance? Suppose we double the length of the wire, keeping the same thickness, then if we make the generator larger, putting twice as much wire on the main part of the revolving bobbin, and also make the motor at the other end larger, putting also twice as much wire on it, and if we run each at the same speed as before, then everything will be doubled, the electro-motive forces and resistances; in fact, twice as much work will be furnished by the generator, exactly twice as much as will be lost in conversion into heat, and about twice as much by leakage, so that the amount given out by the electro-motor at the other end will be about twice as great. Consequently, if we make the distance 100 times as long, using just the same thickness of fine wire, almost the same proportion will be lost as was wasted in the transmission over the short distance, provided 100 times as much energy is transmitted per second.

Electric transmission of power then becomes not only practical, but very economical both for short and for long distanecs, if we run both the generator at the one end of the line, and the motor at the other sufficiently fast, and if we only require to transmit a sufficiently large quantity of power.

But this latter requirement is the essence of all successful trades, viz.: that the percentage of profits shall increase as the operations grow in magnitude.

We have been considering the transport of power derived more especially from natural sources; but since we have seen that by the use of electricity, properly employed, the waste of power in transmission can be reduced for any distance to about thirty per cent. of the whole power absorbed at the generator, it follows that the employment of steam engines of vast size at points outside Sheffield, would be by far the most economical mode of extracting the energy out of coal. For it is at least four times as expensive to produce power with a small steam engine as with a large one; therefore including the waste of power in electric transmission, the cost of production of power in small workshops would be little more than one third as dear as if small steam engines were used, and similarly the waste of power in any large mill or factory in its transmission from the large steam engine at its base to all the floors and machines on each floor would be very much diminished.

Consequently it would be much more economical to work this lathe on the platform, as I will now proceed to do, by a big steam engine in Howard Street, several hundred yards away, than to use a small steam engine here for this purpose

But you will say that in advocating the employment of electricity I am advocating a total change in our mode of producing and transmitting power. Is the probable gain worth the expense of the necessary change?

To answer this question we must consider what would be the probable minimum annual gain by the proposed change in Sheffield alone. In making this calculation we must remember that not only can electricity produce motive power, but also heat and light, and electric heating and lighting have this great advantage that no chimneys are required.

For example, with the electric current sent here from Messrs. Walker and Hall's works I can heat this long coil of iron wire white hot, so that when put into the vessel of water, the water, you see, in a short time begins to boil. In fact, the stoker has put coal on the fire at Howard Street and boiled water with it here in the Albert Hall.

Again, it is almost needless to tell you that electric lamps can be lighted by a current produced at a considerable distance from the lamp, seeing that I have been using several times, for projecting images on to the screen, an electric lamp fed by the current produced in Howard Street. However, we will now light up this entire hall by one electric lamp, receiving its current from the same workshop, and by another for which the electric current is produced in the yard of the Sheffield Water Company by a water engine, and transmitted by the wires crossing the street, as shown in the diagram.

Various calculations have been made as to the relative cost of lighting by burning coal to produce gas, or by burning coal to work dynamo-machines for producing electric currents, and it seems to be pretty certain that if a large amount of light be required in one place, that the electric light is at least twenty times as cheap as coal; Sir William Thomson, our eminent electrician, goes as far as to say that it may be made 133 times as cheap. And certainly that there is a great saving in expense in electric lighting is seen from the actual result obtained at the Albert Hall, London, which is an example, and perhaps the only example in connection with electric lighting, where the science of putting a brilliant light high up has been allowed to ride over the precedent of putting a number of feeble glimmers all over a building.

Now, the duration during which the electric light is used at the Albert Hall on any one evening is only three hours, the time of the performance, so that the cost of getting up steam before the light is used, and the waste of heat after the engine is stopped, constitutes an important part of the whole expenditure. However, including this and other disadvantages under which Dr. Siemens labours in this matter, the actual cost, including labour of men, allowance for wear and tear of machinery, &c., is only one-third of that of the former

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inferior gas lights, and thus a saving of about thirty shillings an hour has been effected.

And in addition to this money economy, a great and almost unexpected gain has been attained. For the smaller amount of noxious gas produced in the electric arc, than in burning the necessary amount of gas to produce even an inferior light, makes ventilation at the Albert Hall, London, now a less important question. And the smaller amount of heat at present produced causes less draught, so that taking the two things together the air is much more steady. But steady air of uniform temperature is very transparent for sound, while layers of air of unequal temperature are opaque to sound. Consequently this stillness of the air, arising from the use of the electric light, enables the singing and music to be better heard, an advantage of enormous importance in so gigantic a concert hall. As a striking contrast with the delightful coolness of the air at the Albert Hall, London, was the warmth of the brilliantly gas-lighted ball-room at the Cutlers' Hall on Thursday evening, and which was only surpassed by the warmth of the reception offered to the British Association by your Master Cutler.

Lighting streets by electricity has not been so successful, economically, for the simple reason that instead of having a large bright light, at a considerable height, reflected downwards, as in the Albert Hall, London, English conservatism has prevented the authorities from grasping the possibility of using for street illumination anything differing from an ordinary iron lamp post. But there can be little doubt that if a few large electric lights, high up, were used for street illumination, the same sort of result as has been obtained at the Albert Hall would be arrived at.

And in connection with the general illumination of a town by electricity there is this important fact to be borne in mind, that all experiments lead to the result that the larger are the dynamo-machines used for producing the electric light, the cheaper is the light produced per horse-power. For example, with this smallest Siemens' machine, which I have on the table, one horse-power gives 600 candles, whereas with the larger machine, such as we are running backwards for driving our emery wheel, circular saw, &c., one horse-power gives 1500 candle power, more than double the light furnished by the other machine; and it is said, although I cannot vouch for the fact, that with the very large machines used in lighting the Palais de l'Industrie in Paris, 6000 candles were obtained per horse-power.

At any rate we may be absolutely safe in saying that the cost of using gas in Sheffield for lighting large halls, such as the one we are now in, factories, and the streets, could be halved if electric currents, generated by water engines worked by hill streams, as well as by very large steam engines, were substituted for gas.

But can this be quite right, for I have proved that to transfer energy economically we must use a large pressure and a small flow. Now, how can we produce a very bright electric light with a small current? Why, by not using the current that comes along the wire to produce the light at all, but merely to drive an electro-motor, which motor, at the place where any large amount of light was required, would be employed in giving motion to a second dynamo-electric machine, which would produce the currents for lighting purposes.

This experiment I might show you, but as we have used already several times during the evening electric lights fed from a distance, we will vary the experiment and try an analogous one. Messrs. Walker and Hall will now, at their works, give rapid motion to a dynamo-machine, and the current which, when properly arranged as I have explained to you may be small, will set in motion this electro-motor. This in its turn will cause this other dynamo-machine to rotate rapidly and produce a current which I will use for rapidly gilding this piece of plate.

It is not necessary for me—and, in fact, time would not allow me—to tell you how I propose to employ the electric light to illuminate private rooms, if only I can get people to throw away the notion that to light a room we must have something with a globe on it, like an oil lamp; nor is it necessary for me to remind you that by whitewashing the walls, yes by whitewashing even the very machines themselves in some of the Paris factories, the supposed strong shadows cast by the electric light have been less than the strong shadows cast by another bright light, one that we not only put up with, but one that from the force of habit we are tolerably contented with, viz., the sun.

At present, I am concerned with the pounds, shillings, and pence question, which has more than usual weight in these days of slack trade. Well then, assume the cost of gas used for lighting the large buildings, factories, and the streets of Sheffield can be halved, also, that where it is used for heating purposes the expense can also be halved, by substituting electric currents generated by very large steam engines at certain points, and by turbines driven by falling water out of the town; then you would save per year about £45,000. Suppose, also, that the cost of producing motive power can in the same way also be halved, this represents an annual saving of something like £60,000. In reality, I believe this last economy would be larger, since not only could power be produced so much more economically than by small steam engines or even by a large engine, when a large proportion of its power is, as now, wasted in driving the shafting alone in your factories; but, in addition, much hand work could be economically replaced by machine work. And, lastly, suppose the consumption of coal in Sheffield for heating your metals and for heating your houses could also be halved, then there is another saving of about £300,000 a year, or, altogether, the annual saving that might be produced in this town alone, by substituting electricity for coal would be something like the large sum of £400,000.

It is hardly necessary for me to point out to you how much capital a company would be willing to advance for such a comparatively certain profit yearly, or whether a large portion of this saving could not be effected by expending only a portion of this capital.

But I think I hear you saying this is all very nice, but there must be certainly something wrong in it all: is it likely that Sheffield could save £400,000 a year by merely using machines to whirl round coils of wire to produce electric currents?

If that be the impression this lecture is producing in your minds, and I can hardly expect the more thoughtful to at once accept the truth of so novel a reform as I am here advocating this evening, and which probably you are listening to for the first time, allow me to adduce the following arguments to prove that although the reform is startling it may still be sound:—Imagine the cost of cutlery and plated goods to remain the same as at present, but all machinery to be removed from Sheffield, then what an enormous loss would accrue to the town from everything having to be done by hand labour. The saving then I am showing you how to obtain, enormous though it may be, is still small when compared with the gain that the introduction of machinery during the last hundred years has effected for this town.

Or again, it may be objected that I talk of using water power at the hillside to drive turbines. But this water cannot come afterwards into Sheffield for drinking and other purposes, because to do work it must lose

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head. We must therefore waste at the source all the water we use for power. But has the Sheffield Water Works any water that can be thus dispensed with in the town? Assuredly, thanks to the energy and perseverance with which the Sheffield Water Works Company have conducted their operations, there is always in hand a very large stock of water. For instance, at present there is in the reservoirs at Redmires, Rivelin, Agden, Strines, &c., enough to last the town for six months if not another drop of rain falls (which is a far more unlikely occurrence than that every Sheffield manufacturer will speedily adopt electricity), and when the reservoirs at Damflask and Dale Dyke, now completed, but not yet in use, are employed, there will be at any time, I understand, a year's supply of water in the reservoirs, even if the consumption of Sheffield somewhat increases.

Bearing this in mind as well as the fact that the Company has also power to construct two other reservoirs, in the Ewden Valley, it will be seen that there is no lack of water, and I am sure there will be no lack of willingness on the part of the Company to allow water at the source to be used, especially when such an arrangement can be made renumerative both to themselves and to the manufacturers.

As an example of what water power can do, we will now cut a two-inch board with a circular saw driven by an electric current produced by the water motor in the yard of the Water Company, and conveyed to this hall by the wires crossing the streets.

So much for what may be done by electricity in producing motive power. Now, let us consider what has been actually done. Last year, two French engineers, MM. Chrétien and Felix, at Sermaize (Marne), actually ploughed fields by electricity, the electric current being produced by two dynamo-electric machines, of a form invented by M. Gramme, and shown in the diagrams on the walls. These machines were usually worked with a steam engine at some convenient place three or four hundred yards away in an adjoining road and the electro-motors were also two Gramme machines, one on each side of the field, with their coils revolving of course backwards. Through one of these, the electric current was sent alternately so that motion was given to one or other of two large windlasses, one on each of the waggons containing the electro-motors. In this way the plough which could be used going in either direction, was first pulled across the field making a furrow, and then back again making another parallel furrow.

A photograph, taken on the spot, of one of the complete Gramme electro-motors, with its windlass and waggon, together with the double acting plough, will now be projected on to the screen.

A second photograph is now projected on to the screen of M. Chrétien's electric crane for unloading boats. This also has been successfully employed for several months at Sermaize, in the harbour there, and it is considered that a saving of about thirty per cent. has been effected of the expense formerly incurred for unloading the sugar barrels out of the boats.

If electricity were produced in large quantities at certain centres, then one difficulty that would of course be met with would be that of distributing it properly, since, just as in the case of water or gas, if a large branch pipe in a main be suddenly opened then the supply going on to the other branch pipes in the same main will be diminished, a result causing serious inconvenience in the case of electric lighting. But just as automatic governors have been devised for water and gas, to keep the supply constant, so automatic "electric current regulators" have been devised by M. Hospitalier and by Dr. Siemens, to keep the current constant. One of those invented by Dr. Siemens is on the table before you, and the general principle of its construction is easily understood. As the current passes through the regulator it heats a certain very thin ribbon of steel, which consequently expands. The effect of this expansion is to introduce coils of wire into the circuit, the extra resistance of which diminishes the strength of the current. Consequently the stronger is the current the more is it automatically resisted, and the weaker it becomes the less is it resisted, and so it remains practically constant at any desired strength for which the regulator is previously adjusted.

The peculiar advantage of Dr. Siemens' regulator is its rapidity of action, since, as the strip of steel has very little mass and a large radiating surface, its temperature alters very rapidly for a small change in the amount of heat produced in it per second, that is, for a small change on the current flowing through it.

But our electric current would be affected in another way. While the supply of energy and heat required in a town is fairly constant from day to day, the velocity of water on hill streams is great after floods, and small in dry weather. Must we, then, have a sufficient supply of dynamo-machines, so that even in a drought we can transmit, electrically, sufficient power; if so in times of rain, like the present, the waste of water power would have to be enormous; or is it possible in any way, cheaply, to store up electric energy during an abundance, and use it during a scarcity? Assuredly, cannot we decompose acidulated water producing oxygen and hydrogen, an operation which experiment has shown will go on quite as easily when the gases produced are under enormous pressure, and occupy very little space, as when the gases are only under the pressure of the atmosphere, as they are in this voltameter from which you observe they are coming off as I pass the current through it. In these two very thick iron bottles I have stored up, under enormous pressure some of this oxygen and hydrogen, and we will liberate a little of the bottled up energy, producing, as you see, this bright oxy-hydrogen light.

Now, assume the pressure of the gases in these bottles is only thirty times as much as the ordinary atmospheric pressure, then the energy given out by the hydrogen contained in one of these bottles, only a square foot inside, combining with the compressed oxygen, in another bottle, having its internal capacity only half-a-square foot, would be no less than 110 million foot pounds, or about the same as 60 horse-power developed for one hour, or one horse-power developed for two days and a half.

Decomposing acidulated water under great pressure by means of the electric current not only then enables us to store up electric energy, but to store it up in an extremely compact way.

But is there no other side to this question? We are, it is true, a commercial people, but do we not still love our hills and our fields? There was a time when the cutler of now black, grimy Sheffield was very fleet of foot in following the chase. There was a time when "Not only in the villages around old Sheffield," so says the history of Hallamshire, "were the file makers' shops or the smithy to be seen, with the apprentices at work; but even on the hill-side in the open country, at the end of the barn would be the cutler's shed, whilst in the valley below, by the river, was the grinding wheel ready to sharpen the tools that had been manufactured."

And why not now? Why should not that mountain air that has given you workmen of Hallamshire in past times your sinew, your independence of character, blow over your grindstone now? Why should not division of labour be carried to its end and power brought to you

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instead of you to the power? Let us hope then that in the next century electricity may undo whatever harm steam during the last century may have done, and that the future workman of Sheffield will, instead of breathing the necessarily impure air of crowded factories, find himself again on the hill side, but with electric energy laid on at his command.

Time will not allow me to tell you more. Some of my ideas regarding electric transmission of energy you have heard; and whether you think these ideas are right, or whether you think them wrong, I venture to hope they may be regarded as worthy of careful consideration, for let it not be said that you, that I, that any of the workers of Great Britain, are allowing by a disregard of scientific principles, are allowing by a neglect of technical education, England's far famed pre-eminence to pass away; let rather our grandchildren, as did our grandfathers, hear that in all that is right, England takes the lead; and when we find we can no longer maintain that superiority by the abundance of our coal, then let us maintain it by the abundance of our knowledge.

Some Experiments with the Induction Balance.

By W. CHANDLER ROBERTS, F.R.S., Chemist of the Mint.

MR. ROBERTS stated that the instrument, which we owe to Prof. Hughes, the discoverer of the microphone, appeared to be one of no ordinary importance; and although the experiments about to be described were far from complete, they possessed sufficient interest to warrant their being submitted to the Section. He then described and exhibited Prof. Hughes' instrument, showing the extreme delicacy by which changes in the induced current were indicated by the microphone and telephone.

The relative values of different metals, as indicated by the induction balance, do not accord with the values usually accepted as representing the relative conductivities of the respective metals, and, this being the case, Mr. Roberts had ascertained what relation the indications given by alloys, when under the influence of the induced current, bear to their electric conductivities.

The experiments on a comprehensive series of alloys proved that, in the case of alloys of certain metals, the induced current curves closely resembled those representing electric conductivity, but that, in certain other cases, the induced current revealed differences that had hitherto escaped observation. As an example, Mr. Roberts alluded to the curve of the copper-tin alloys, in which there is a sudden break between the points representing two alloys, which only vary by a single equivalent, or by 6·4 per cent. of copper. These two alloys are widely different in colour, fracture, density, and structure, and the induction balance at once afforded evidence of a marked difference not shown in Matthiessen's curve of electric conductivity.

It is known that certain metals, when alloyed, undergo a molecular change, and that an allotropic condition may, in some cases, be induced by alloying a metal with a small quantity of another, facts which will, doubtless, receive careful examination from those who are pointing to the non-elementary character of certain metals.

Mr. Roberts then referred to the question of applying the induction balance to the assay of metals. In the case of gold-silver alloys, the instrument will show the presence of less than two grains of gold in the pound of silver. On the other hand the silver-copper alloys used for coinage are situated at the flat portion of the curve, so that it is impossible to detect even considerable differences in their composition; and these alloys, which are very peculiar in their nature, appear to be greatly affected by annealing. More hopeful results were obtained with the gold-copper alloys, and Mr. Roberts demonstrated a difference of 1 per cent. in the standard of two gold discs, which, though far short of the existing method of assay, in delicacy appeared to afford grounds for the belief that very accurate results will ultimately be obtained.

Recent Advances in Electric Lighting.

By J. N. SHOOLBRED, C.E.

THE author said that twelve months ago very little was, comparatively speaking, known of the electric light, whereas now there was no town in England of any magnitude in which experiments had not been made. The progress in the electric light had been very great. The great desideratum was the production of a number of smaller lights of less intensity in place of producing one light only of great intensity, and great progress had been made towards the solution of the difficulty. The question of the relative sanitary effects of the illumination by electricity and also by gas had received considerable attention, and the result had been considerably to the advantage of electric illumination. The author then gave an explanation of the various processes of electric lighting now in vogue, in the course of which attention was drawn to the lamp of M. Heinrich, a description of which we illustrate elsewhere.

On the Retardation of Phase of Vibrations transmitted by the Telephone.

By Professor S. P. THOMPSON.

DUBOIS-REYMOND predicted from theoretical considerations that a difference of phase, amounting to a quarter of a complete vibration, would be found to exist between the diaphragms of two Bell telephones, joined up in one circuit, the receiving telephone being a quarter of a vibration behind the transmitter. Helmholtz and Weber theoretically predicted only a small difference of phase. Recently König in a series of delicate experiments, effected an optical comparison by the method of Lissajous, of the vibrations of a pair of telephones, replacing the vibrating discs by tuning-forks armed with mirrors. The author has proposed the following method of observing. A pair of Bell telephones are suspended by wires of about a metre in length, so as to oscillate as pendulums, to frames so disposed as to avoid the possibility of any mechanical transmission of the vibrations. Below the point of rest of each telephone, and at some little distance from it in the plane of its swinging, is placed a steel magnet. After the lengths of the wires have been so adjusted that the telephones will swing in identical periods, one telephone is set swinging. As it alternately approaches and recedes from the magnet, the induced currents traversing the second telephone set it swinging. In every case the difference of phase observed amounted to one quarter.

In the case of those telephones which transmit vibrations by varying the resistance of the circuit,

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instead of varying the electro-motive force, there is no such retardation of phase produced in the ordinary electro-magnetic receiver. If, however, the current so transmitted is first passed through an induction coil, a retardation of phase of one quarter is produced, and in the case of several successive inductions the retardation amounts to an additional quarter for every additional induction. This remark applies only to vibrations of harmonic and quasi-harmonic type.

In the case of Edison's motographic or electro-chemical receiver, the velocities, not the displacement of the disc, are proportional to the strength of the currents received. Hence vibrations already retarded one quarter in transmission, as is the case with those of the carbon transmitter in conjunction with its induction coil, always used with this instrument, are restored to their primitive phase. The vibrations of this receiver therefore agree with those corresponding to the function of which the vibrations of the induction current are the derivate; that is to say, they agree in type with the primitive vibrations of whatever form. In the receiving telephone of Edison, therefore, consonantal sounds which depart widely from the purely harmonic type are better rendered than in a telephone which like that of Bell both retards the vibrations in phase and alters them in type.

Report of the Committee on Atmospheric Electricity in Madeira.

By DR. M. GRAHAM.

REMARKABLE fluctuations of the electric potential were noticed at the time when the maximum potential is reached, which takes place at 11.30 a.m.; this fluctuation the writer ascribes to masses of cloud on moist air. The daily formation of a thin stratum of cloud during fine calm weather which varies slightly in altitude in accordance with temperature and barometric pressure was described. The electricity below this cloud is always positive and moderately strong. In the cloud itself it is more feeble but of the same sign. Above the cloud at the station where the observation was taken it was very feeble and irregular but always positive. In warmer weather the vapour does not condense into cloud but appears as a blue transparent haze from above, and presents the same electrical indications.

The highest potential was observed upon a rock ninety feet high, a few metres from the shore in the Bay of Funchal.

The thinness of the currents of air constituting sea breezes was demonstrated by flying a kite vertically beyond into the true wind blowing in a contrary direction. Abortive attempts were made to bring down the upper electricity through the lower currents. The electricity of the general north east wind which is identical with the trade wind was found on the heights at the east end to be uniformly moderate and positive.

At the approach of rain-clouds at the termination of a period of fine weather the atmosphere invariably gives increased readings and no negative observations were recorded.

The L'este, a kind of sirocco to which Madeira is occasionally subject, electrically gives no indication of any change whatever except by faint fluctuations about the earth reading.

During the prevalence of L'este wind, the writer noticed a very highly electrical condition of certain clouds which lie quietly among the mountains, though tossed and tumbled on their upper surfaces; he hopes to be able to connect their forms and immobility with their electrical change.

HEINRICHS' ELECTRIC LAMP.

By C. F. HEINRICHS.

THERE have been lately many systems of electric lighting shown to the public, in which the production of small lights for the purpose of superseding gas has been quite successfully effected; but, from a financial point, they have not been quite satisfactory, as the unpracticability of the subdivision of the electric current for lighting purposes without loss has been often proved.

The only field in which electric lighting has already superseded gas, both as regards its being superior in illuminating power, and also its being actually cheaper than gas, has been where large lights (1,000 to 6,000 candle power) have been employed, and in which the consumption of the carbon pencils has been regulated by clockwork.

The only drawback in this line has been the inefficiency of the regulating mechanism; thus the light becomes extinguished frequently, and in some lamps it takes from 4 to 10 seconds before they are relit, and a disagreeable flicker is the result.

In almost all regulators, where the consumption of the carbon is regulated by clockwork, in conjunction with an electro-magnet, the current which produces the light has to pass through this magnet, and the increase or decrease of the current increases or decreases the attracting power on the armature of the same, which stops or releases the clockwork. I have found always that when the armature releases the clockwork and the carbon feed, the increase of the current does not take effect at once, not in proportion to the feed, and not until the arc covers again sufficiently and equally the new advanced mass of the positive carbon, and this sometimes takes from 2 to 10 seconds of time. Now in this time the clockwork is free, and the carbons keep feeding, and, therefore, are liable to come too close together, which produces the disagreeable hissing noise so often observed; or else, by the carbons coming quite together, the great increase in the current flowing in the circuit causes the generator to become heated, and its insulation thereby to be impaired.

That the increase of the current does not take effect at once when the carbons feed, will be explained by the fact that the heated carbon is a better conductor than the cold, therefore the current cannot rise to its maximum power until the new advanced mass of carbon is equally heated, and not until then does the arc equally cover the positive carbon; when again the arc becomes most conductive, and the current most powerful, then by its acting upon the armature of the magnet, it prevents the carbon from further feeding.

It will, therefore, be evident that regulators should be so constructed that when they are extinguished by accident they shall re-light instantaneously; and, secondly, that the carbon points shall never come actually in contact while burning.

The last point has been already effected by the candles of Jablochkoff, Wilde, &c., in which the arc is kept always of the same length. But these candles burn only with alternate currents, and the continuous currents have always proved their superiority in light power against alternate currents; also as

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several small continuous current dynamo-machines can be placed on the same shaft, *i. e.*, constructed in one machine, therefore there is nothing to prevent the continuous current dynamo eventually superseding the alternate current machine if the successful introduction of regulators and candles, in which the before mentioned obstacles are overcome, can be effected.

J. N. Shoolbred, C.E., in his paper read before the British Association in Sheffield, exhibited among other novelties, Charles F. Heinrich's regulators and candles in which the carbon points can never come in actual contact while burning, and in which the light if accidentally extinguished, is relit partially instantaneously; the lamps also possess several novel features, which are very advantageous, when large open places and public halls have to be lighted up.

Perhaps the chief novelty in the regulators and candles lies in the application of *circular* carbon pencils, instead of straight ones. This in the first place triples the burning time. Secondly, the circular carbon pencils allow these lamps to be so constructed that the mechanism which holds the carbon is placed *above* the arc; the inconvenience and loss of light caused by the shadow of the mechanism which exists in most other lamps is thus avoided.

Figs. 1 and 2 show the regulator by which the feeding of the carbons is effected.

From Fig. 2 it will be seen that the metal arms that hold two carbon pencils are kept apart by two chains (which may with advantage be two racks) connected with the regulating mechanism. The two arms fall in different directions by their own weight, but by crossing one of the chains the pulley to which both chains are attached will move in only one direction. This pulley gears with the spindle to which is fixed an escapement wheel and a ratchet wheel; upon this ratchet wheel the lever to the right with the pawl acts, and by its movements separates the carbons, and upon the escapement wheel the lever to the left with the two pallets acts and regulates the feed of the carbons in the following manner:

When a current is sent through the carbons for producing the light, it has to pass through both the magnets, as shown in Fig. 1, this will cause both armatures to be attracted, thus bringing both levers in action.

The lever to the right, by leaving the dotted position, releases its pawl from its lifted point, drops it into the ratchet wheel, turning the latter as it moves forward to its limiting position; the amount of this motion is sufficient to separate the carbons for starting the arc. Before, however, the lever comes to a stop, it lifts the pawl out of the ratchet wheel by means of a stud, thus leaving the wheel free, but as at the same time the armature on the left with its lever comes into action, the outer pallet prevents the escapement wheel from returning, thus keeping the carbons separated.

When now the carbon points become too far apart by burning away, the current becomes feeble, the magnet on the left loses some of its power of attraction, and allows the spring between the lever and inner pallet to come into action which forces this lever with the outer pallet backwards, thereby allowing the escapement wheel to advance, and to press the inner pallet (which is pivoted to the upper end of the lever) forwards, and this permits the escapement wheel to advance $\frac{1}{8}$ths part of a tooth, which tooth is then stopped by the inner pallet.

By this action the carbons come sufficiently together to increase the current, and thus the magnet on the left gains power, the armature will slowly (it is somewhat curious, but a fact that this action takes place *slowly*) again be attracted, the lever presses the inner pallet against the stud, and causes this pallet to leave the escapement wheel, and then the outer pallet returns to the escapement wheel, thus allowing the latter to complete the other $\frac{1}{8}$th part of a tooth.

Through this alternating play of the two pallets into the escapement wheel its advance will be regulated step by step so as to ensure the maintenance of the right distance of the arc.

If no current passes the lamp both levers will be withdrawn so that there is nothing to prevent the carbon points from coming in contact at once.

The lever to the left will be withdrawn by the spiral spring, which spring is so weak that it only withdraws the lever, if no current passes the lamp, or if the lamp becomes extinguished. The feed action, as before described, is produced by the spring between the lever and inner pallet. This combination prevents the carbon from coming into actual contact while burning.

If the current should be suddenly broken or the lamp extinguished the carbon will thus immediately come in contact, and be relighted at once by the rapid action of the magnet to the right with its separating mechanism before described.

These regulators can be constructed for any current whether alternate or continuous.

Fig. B shows the form which the points of the carbon assume when alternate currents are used. Fig. A shows how one carbon can be set above the other so as to cause the light from the arc to be directed downwards.

Besides the foregoing, I have succeeded in the construction of candles with circular carbon pencils, in which no clockwork nor any mechanism is required for the feed of the carbon. In this arrangement, which is shown by figs. 3 and 4, two sets of circular carbon pencils cross each other, and the arc is started and maintained at their crossing points.

The lower set of circular carbon pencils is connected to the negative pole (if used for continuous currents), and the upper set, which crosses the lower set, is connected with the positive pole, and the upper set is movable, and fixed to the armature of an electro magnet. If no current passes through the candle, the upper set rests in contact with the lower. If a current passes, then the armature of the magnet will be attracted, and the arc be started between the crossing points of the two sets, in consequence of the upper set being withdrawn sufficiently from the lower set to maintain the required distance of the arc. The feed of the carbons takes effect without changing the distance of the arc, and is done entirely automatically through the weight of their respective holder arms.

These arms have on their turning point small bevel wheels, between which is geared a pinion—one to each set—this pinion prevents the arms from falling unequally, and keeps the burning point always in the same place. When alternate currents

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REGULATORS

Fig.1.

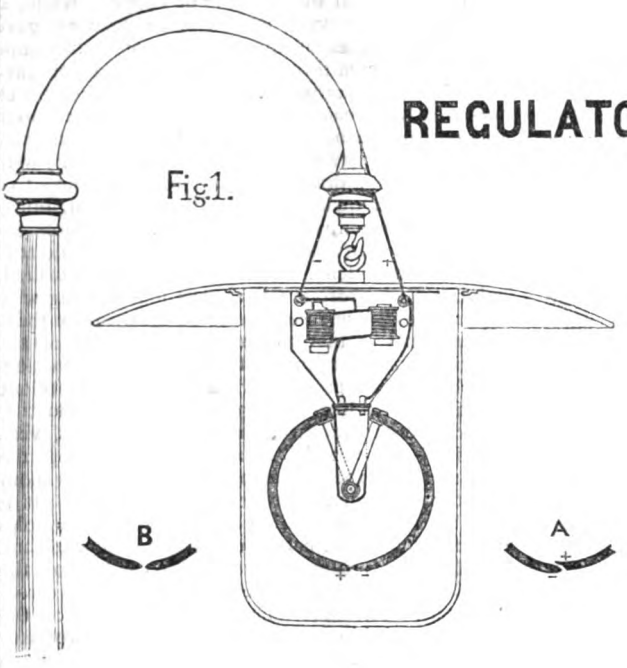
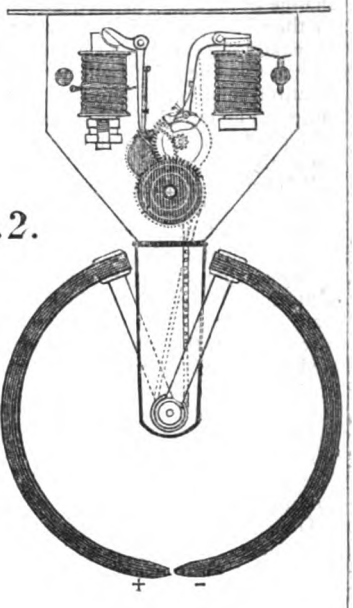
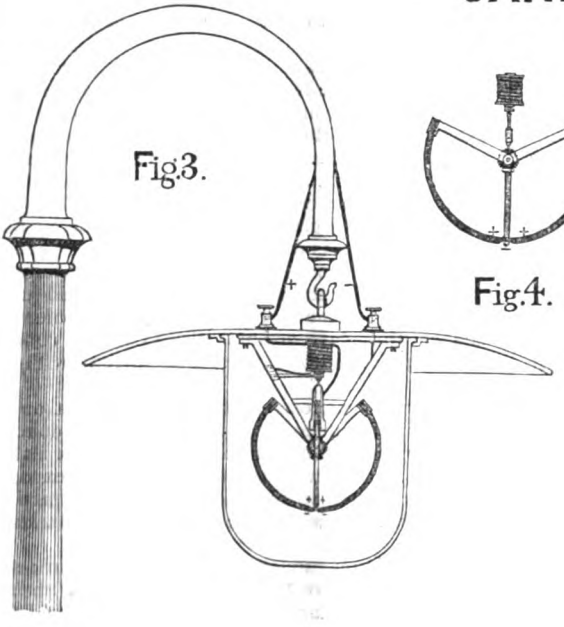


Fig.2.



CANDLES

Fig.3.



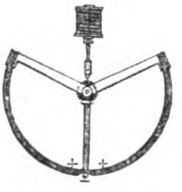
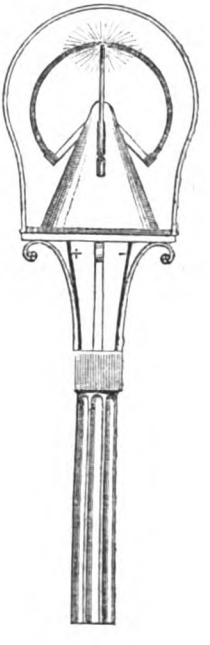


Fig.4.

Fig.5.



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are used, all four points will become nearly pointed. Fig. 5 shows the candle arranged on a lamp post, the carbon points, in this case, being set upwards. These candles may be constructed for any size of light, and will burn from 10 to 24 hours without change of carbon; in fact, an advantage is gained by their being made in that shape. It is very difficult to make long carbons accurately straight, and unless they are so the points will not preserve their proper position relative to one another when set in the lamp. The circular carbons being made in the form of a ring, and then cut into two parts, accurately keep their annular form, and always, therefore, will burn with their points in the same relative position.

An important point attained by the use of the circular carbons is economy of space and portability; when straight carbons are used, it is evident that the length of the space occupied by the lamp cannot be less than that of the two carbons, whereas with the circular carbons the length occupied is reduced to less than one-third, thus rendering the lamp very compact. Practically, also, it must be evident that long carbons could be used without inconvenience, and thus the lamp could be kept burning for a very long time without renewals. The manufacture of the circular carbons presents no difficulty whatever.

The whole system is most economical for lighting public halls and large open places, as the lamps can be fixed at an unusual height, with a reflector and glass globe, so that rain, wind and dust would have no effect, whilst they will cast their light to a long distance.

PRODUCTS OF THE VOLTAIC ARC.

SHORTLY before his death, the late Professor T. Wills, of Greenwich Naval College, made the important discovery that nitric oxide is formed in the voltaic arc. More recently Professor James Dewar, of the Royal Institution, has determined the curious fact that hydrocyanic, or prussic acid, that deadly poison, usually distilled from laurel leaves or bitter almonds, is formed in small quantities in the voltaic arc.

A series of experiments favouring the conclusion that the so-called carbon lines are invariably associated with the formation of acetylene (as suggested by Plucker, Angstrom, and Thalén) induced Professor Dewar to make some experiments to ascertain whether this substance can be extracted from the electric arc, which invariably shows this peculiar spectrum at the positive pole, when it is powerful and occasionally intermittent. For this purpose the carbons were used in the form of tubes, so that a current of air could be drawn by means of an aspirator through either pole, and the products thus extracted from the arc, collected in water, alkalies, and other absorbents. Gases may be led through one of the poles, and suction induced through the other, in order to examine their effect on the arc. The experiments were made by means of the Siemens' and De Méritens' magneto machines. Hydrogen led in by the positive pole, and the gases extracted, gave the well-known acetylene compound with ammoniacal sub-chloride of copper; while, at the same time, a wash-bottle containing water gave distinct evidences of the presence of hydrocyanic acid. Air drawn through the negative carbon gave considerable quantities of hydrocyanic acid, which was greatly increased by extracting the gases through the positive carbon. Carbons purified in chlorine and hydrogen gave with De Méritens' nothing; with Siemens', and a draught of air through the negative pole, a small quantity of hydrocyanic acid, but a larger yield when positive was used. The gases extracted after the absorption of the hydrocyanic acid contained acetylene. If the carbons are not purified, sulphuretted hydrogen is always found along with other gases. The inference to be drawn from these experiments is that the high temperature of the positive pole is required to produce the reaction, which is in all probability the result of acetylene reacting with free nitrogen, as when induction sparks are passed through the mixed gases, viz.: $C_2 H_2 + N_2 = 2 H C N$, and that the hydrogen is obtained from the decomposition of aqueous vapour and the combined hydrogen in the carbons. It is possible traces of alkaline salts in the carbon poles may favour the formation of hydrocyanic acid, but, as all attempts to purify the poles so as to stop the reaction failed, I am inclined to believe it is a direct synthesis. The acetylene reaction is one of the many remarkable syntheses discovered by Professor Berthelot, of Paris. The presence of sulphuretted hydrogen is doubtless due to the reduction of the sulphates, invariably present in the ash of the carbon. A more complete examination of the various reactions to be brought about by means of the Siemens' arc, and with poles of varied composition, and in presence of different gases, will be communicated to the society in a subsequent paper.

The hard diamond-like deposit of carbon, which after a short time is found to obscure the interior of the globe of an incandescent carbon electric lamp, like the Sawyer-Mann, has also been made the subject of analysis by Mr. B. S. Proctor. The lamp examined was made by Mr. J. W. Sivan, and exhibited to the Newcastle Chemical Society in December last year. It consisted of a glass flask, which after being filled with nitrogen was exhausted by a Sprengel, and an incandescent pencil of carbon. It was, therefore, supposed to contain nothing which could carry carbon from the glowing pencil to the cooler surface of the glass around it. Platinum contacts were employed to connect the current with the carbon.

Under the microscope the smoky deposit on the glass showed numerous bright globules, no doubt of platinum, and more minute particles of dark matter, nebulous, under a $\frac{1}{4}$-inch objective. On exposing the glass to an oxidising heat, the deposit partially disappeared, still leaving the glass partially darkened however.

The platinum support was coated with dark sublimate. The deposit on the glass was not entirely dissolved by *aqua-regia*, and analysis showed that the soot contained platinum, carbon, and iron. The platinum globules might result from the disruptive discharge which took place at the moment the lamp failed.

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Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I observe from your description of the Siemens-Alteneck Alternating Current Machine, which was illustrated in your last issue, that the principle of the apparatus is that of employing flat circular bobbins moving through magnetic fields of alternating polarity. I would call your attention to the fact that the use of such an arrangement was described in my patent, No. 4,432, 1877, the illustration of the same being on sheet 6 of that specification.

I am, Sir, &c.,

London, 10th *September*. J. RAPIEFF.

Notes.

THE Belle-Cour Theatre at Lyons is to be lit by electricity.

THE *Journal Telegraphique*, for August 25th, contains a detailed *annexe* to the International Telegraph Convention of St. Petersburg, embodying the revision which took place during the recent conference at London.

EDISON'S latest electropyre, or electric burner, consists of a small cylinder of pure zircon, heated to whiteness by a surrounding coil of platino-iridium wire.

EDISON'S call for platinum for his electric lamp has been responded to with interest by Western "prospectors," and a crystalline vein of it has been found in a seam of talc in Santa Clara County, California. The schistose rock in which the talc is imbedded was found to be so hard, however, that the work of quarrying proved unprofitable. Prof. Stewart, nevertheless, thinks that with proper tools it might be made to pay. Drift platinum was once found along with gold in old diggings of Trinity and Humboldt Counties, and the same authority recommends search in that region.

THE s.s. *Faraday* has returned to the Thames after successfully laying the ocean section of the new French Atlantic Cable from Brest to St. Pierre, a distance of 1800 miles.

THE s.s. *Dacia* recently left for the Mediterranean to lay a duplicate cable between Marseilles and Algiers, which has been made by the India-rubber and Gutta-percha Telegraph Company. Mr. W. H. Preece, who recently suffered an injury to his leg which incapacitated him from active service, has, we believe, gone with her as a guest. Mr. Graves is also on board.

THE remains of the late Sir Rowland Hill, the originator of the penny postal system, were interred in Westminster Abbey on Thursday, September 4th, at noon. The funeral, which was very plain, was attended by many eminent men, statesmen, representatives of the postal department, and old friends. The service was conducted by Canon Duckworth.

CAPITAL PUNISHMENT BY ELECTRICITY.—Electricity is regarded by many as the probable means of legal punishment by death or torture; and the Paris papers are forcing these views to take a practical shape by discarding the guillotine and substituting a fatal electric shock instead. By electricity, they argue, instantaneous death can be inflicted without the hideous and unclean concomitants of the decapitating machine, and with the certainty that consciousness will not survive the stroke. We are not so sure of this latter result in all cases, at least at first, but, doubtless, steps would be taken to guard against miscarriage of penalty. The death would be painless, for it would occur before the organs of feeling could act, and therefore it would be humane. There is reason to believe that when the French Chamber reassembles a bill will be brought in to effect the end in question.

A CURIOUS ACOUSTICAL ILLUSION has been pointed out by M. Plumandon, of the Puy de Dome Observatory, which some of those who use a pair of telephones in receiving may have observed. With a single telephone held, say to the right ear, the transmitted voice appears to come from a distance to the right; while with a telephone held to the left ear, it seems to arrive from the left of the listener. With a telephone to each ear if one ear be less sensitive than the other, or if the telephone be held farther from that ear, the voice shifts to the side of the other ear; and if both ears hear alike and both instruments are equally near their respective ears, the voice apparently proceeds from in front of the observer.

A NEW comic opera to be produced in Baltimore, America, bears the name of "The Electric Light." Some talented low comedian, a Yankee Lionel Brough or J. L. Toole could make excellent capital out of a burlesque of Edison and his wonderful lamp. Here is an opportunity for histrionic fame.

OWING to the bad state of the telegraph lines to Morocco, messages are now sent by post from the South of Spain. Those for Tangiers, Tetuan, and the West Coast of Morocco should be addressed to the Spanish Telegraph office of Tarifa; those for Melila, Chafarinas, Peñon and Albrucemas, to Malaga, and those for Ceuta to Algesiras.

THE death is announced of Herr Lamont, director of the Observatory of Munich, and one of the fathers of electric meteorology.

MR. GADD, the registered proprietor and Mr. Allen, the publisher of the *Investigator*, appeared at the Guildhall Police court, on Thursday, September 4th, in answer to a summons charging them with having published defamatory libels, concerning Mr. Croll, the official liquidator of the United Kingdom Telegraph Company. Mr. Croll gave a general denial of the statements. Mr. Allen intimated through his council that as soon as he had found out that there was anything objectionable in the paper he had ceased to sell it, and requested that his name should no longer appear as publisher. The summons against Mr. Allen was thereupon withdrawn, and that against Mr. Gadd came on for hearing, on Tuesday, September 9th, when it was decided to commit the latter for trial.

MR. CLINTON G. COLGATE, the lawyer who recently obtained an injunction against the Western Union Company of America, for the use of gutta-percha covered wires and cables, has also obtained one against the Gold and Stock Company. The royalty which these companies will require to pay has not yet been decided upon. The Bishop Gutta-percha Company also pay a royalty for manufacture of such wires and cables; but

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they are restrained from supplying these two companies until the litigation has been settled.

THE German-Norwegian Cable, *via* Sylt, has been successfully laid, the work being completed on the 22nd ult., when the town of Westerland at the Norwegian terminus of the line was decorated with the flags of Germany, Norway and England.

A NEW telegraph wire, especially applicable for military lines, is being made and tried in Germany. It consists of a compound iron and aluminum wire, combining lightness with strength and conductivity.

AN attempt is being made to establish a telephonic exchange in Manchester on the American plan. The apparatus to be employed is Bell's receiver and Blake's microphone transmitter.

ST. ELMO'S FIRE was recently witnessed on a magnificent scale in the Jura above St. Cergues. During a thunderstorm which overshadowed the region, a pine forest above St. Cergues was seen to blaze with a light like the phosphorescence of a tropical sea. After every discharge of lightning, however, the fire was momentarily extinguished. Rain had converted the trees of the forest into good conductors, and when the strongly-charged cloud passed over the bristling points of the firs, the induced discharge therefrom gave the whole forest a luminous appearance, which vanished for a time after every withdrawal of the exciting charge by lightning.

EDISON'S CHALK CYLINDER BATTERY.—It has been found by Edison that the chalk cylinder and platinum rubber which he employs in his electro-chemical telephone acts as a battery or generator of electricity giving an electro-motive force equal to half of that from a Daniell cell. Four of these cylinders of prepared chalk were mounted by him on a non-conducting axle, the platinum rubber of each being connected to the metallic boss or journal of the next, and on rotating the axle a current could be drawn off from the last rubber and the first boss of the series. These four cylinders are said to be equivalent to two Daniell cells, but the power varies somewhat with the speed of rotation. The battery has a resistance of 1,200 ohms. when at rest and only 50 ohms. when in motion for ½-inch metallic surface of rubber. Whether the current is due to the chemical solution on the chalk has not yet been determined.

THE ELECTRIC RAY AND THE TELEPHONE.—Some time ago we chronicled the fact that M. Marey had studied the discharge of the electric eel by means of the telephone, and found it to consist of a rapid intermittent current. Taking the hint from M. Marey, another French *savant*, M. Ch. Robin, who first proved that the electric Ray had a battery in its tail, has been investigating the discharge of that animal by the same means. The wires leading from the telephone were terminated by metal plates, one of which was placed on the tail of the Ray near the two caudal fins, while the other was placed on the body itself at the base of the tail at a point where the electric apparatus of the animal is no longer under the skin. The telephone was, of course, applied to the ear of the observer. At each discharge from the larger Rays a dull sound was heard in the telephone, but of feeble volume compared to the sounds produced by the discharge of the eel or torpedo, owing to the small size of the Ray generator. The sound had in fact only a fourth of the intensity of that given by a young torpedo no larger than the palm of the hand.

DISTILLATION OF LIQUIDS UNDER THE INFLUENCE OF ELECTRICITY.—It has been found by M. Gernez that if a liquid be introduced into an inverted U tube, having the platinum electrodes inserted into its two extremities, and connected to a Holtz machine, and if the air is exhausted from the tube leaving the liquid to cover the electrodes, then on turning the machine so as to electrify the two columns of liquid, there will be a passage of liquid by evaporation from the positive to the negative pole. The action is distinct, regular, and, for certain liquids, rapid. This result has been shown by M. Gernez to be due not merely to the heating of the liquids; and he has found that the quantity of liquid transported is proportional to the quantity of electricity in play, and does not depend sensibly on the open surface of the liquid.

ROWLAND'S THEORY OF THE AURORA.—Professor Rowland, of Baltimore, has recently framed a theory of the *aurora borealis*, which is founded on the supposed electrification of the earth—for the most part on the exterior of the atmospheric envelope. According to it, air currents from the equator carry the electricity towards the poles, where the descending air leaves it, and the condensation thus produced in these regions is relieved by discharges, which appear under the guise of northern lights. The total effect of this process would thus be to cause a difference of potential between the earth and the upper regions of the air, both at the poles and the equator. At the poles, however, the discharge takes place in the dry atmosphere. At the equator, the electrostatic attraction of the earth, for the upper atmospheric layers, causes the atmosphere to be in unstable equilibrium. At some spot of least resistance, the upper atmosphere rushes toward the earth: moisture is condensed, and a conductor thus formed on which electricity can collect; and so the whole forms a conducting system, by which the electric potential of the upper air and the earth become more nearly equal. This is the phenomenon known as the thunderstorm. Hence, were the earth electrified, the electricity would be carried to the higher latitudes by convection, would there discharge to the earth as an *aurora*, and, passing back to the equator, would get to the upper regions as a lightning discharge, once more to go on an unending cycle.

ELECTRO-OPTIC PROPERTIES OF LIQUIDS.—In the *Philosophical Magazine* for August, Dr. J. Kerr, of Glasgow, publishes the details of a series of experiments on the power possessed by the silent electric discharge of inducing double refraction in various liquids. The mode of experimenting consisted as follows: the liquid to be tested was placed in a square glass cell, having brass discharging knobs let into two of its opposite walls, so that a discharge from an electric machine could be sent across it between the knobs. Through the liquid in the cell at right angles to the line of electric discharge, a beam of light from a flat paraffin flame, and polarised by passage through a Nicol prism, was sent; and between the cell and the observer's eye, the light passed through compensating plates of strained glass, a neutralising plate, and the analysing Nicol prism. When everything has been properly adjusted, the streak of polarised light reaching the observer's eye, is purposely extinguished; and then the discharge is applied to the liquid, with the effect of restoring the extinct light. With carbon disulphide, which is the best dielectric yet discovered, a small movement of the electro machine, one turn or less, gives a very fine restoration of the light in the polariscope. As the potential rises, the light increases steadily until it is quite brilliant; but if a spark be

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taken upon the knuckle from the prime conductor of the machine at any point, the phenomenon instantly vanishes. Benzol, toluol, xylol, cumol, cymol, terebene, amylene, and carbon dichloride, were in this way found to be very good insulators by this apparatus, in comparing the striking distance of the prime conductor, when the wire connecting it with the cell was in and out of position successively. Valeric acid was found to be a poor insulator, as also was bromotoluol. Nitrobenzol gave no optical effect, and is really a good conductor. Young's paraffin oil, sp. gr. ·814, one of the lightest illuminants made, was found to be an excellent insulator; while another sample of sp. gr. ·890, one of the heaviest lubricants made, is also a good insulator; and no liquid which the author has yet examined, except $C S_2$ is superior to it in the strength and range of its electro-optic action.

WE have pleasure in directing the attention of such of our readers as are interested in photography to the gelatino-bromide dry plates of Messrs. Wratten and Wainwright. These gentlemen succeed in producing plates which for quality, rapidity, and simplicity of development, leave nothing to be desired. Having used them ourselves we do not hesitate to recommend them to all who wish to take photographs of electrical apparatus, and instruments, or retain mementos of the places where they are at present engaged.

A REMARKABLE portable camera, suitable for landscape work or portraits, is sold by the Sciopticon Company, for the small sum of 50s. This will take plates 6¾ inches by 4¼ inches. If a more substantial apparatus be desired, the amateur cannot do better than write to either of the above firms, who supply anything required in photography, and at most reasonable prices.

Reviews.

Instructions for Testing Lines, Batteries, and Instruments, and Guide to the Technical Arrangement of Telegraph Offices in India. By LOUIS SCHWENDLER. Second Edition. Vols. I. and II. Revised by R. S. Brough.

IT is now some years since the series of pamphlets, of which these volumes are a re-arrangement, were written. In issuing the Instructions in the present form, revisions and considerable additions have been made, and necessarily with great advantage. In the hands of such an experienced and able electrician as the late lamented Mr. Brough, much really useful matter has been added. Attention is called, in a memorandum at the commencement of Vol. I., to some of the chief alterations which have been made. The first of these relates to the nomenclature of units, in which we observe that the unit of "Quantity" has been called the "Weber," and the unit of "Current" the "Oersted." Whilst quite agreeing that these names would have been well chosen in the first instance, yet we must point out that the Committee of the British Association, in their report upon Electrical Standards, have assigned the name of "Weber" to the unit of *Current*, and not of *Quantity*, the latter being left without a name, an omission which is to be regretted. Mr. Brough is not, however, singular in his error, as we know of at least one other work in which the same mistake has been made.

In dealing with the theory of the Wheatstone bridge, although the questions involved have been well considered up to a certain point, there the matter has stopped, and the same omission has been made, to which we called attention in noticing Mr. Schwendler's Testing Instructions (the first volume of which was published a short time ago by Messrs. Trübner) viz.:—that, although the conditions for an absolute maximum of sensitiveness are given, yet it has not been shown how widely these conditions may be departed from without materially affecting the object in view. In most, if not all, cases of the kind, this divergence may be considerable; let us take a simple instance. The magnetic force, with a given current strength, produced by the coils of a galvanometer or electro-magnet, is proportional to the number of convolutions within a given space, and also, within a given space the number of convolutions is proportional to the square of the resistance g of the galvanometer or electro-magnet. The current strength flowing through the coils is inversely proportional to the total resistance in the circuit; hence, if we call R the external resistance, we shall have:—magnetic effect M is

$$M = \frac{\sqrt{g}}{g+R} \times K$$

where K is a constant depending upon the electromotive force of the battery, shape of the coil, &c.

Now, if we differentiate the fraction with respect to g, and put it equal to o, we then get the well-known proof that to obtain the maximum effect the resistance of the galvanometer or magnet should equal the external resistance; thus

$$\frac{d\,M}{d\,g} = \frac{1}{(g+R)^2}\left[(g+R)\frac{1}{2\sqrt{g}} - \sqrt{g}\right] = o$$

at a maximum; or

$$g + R = 2g$$

that is

$$g = R.$$

But now let us examine the magnetic effect equation. To do this let us put $R = ng$; we then have

$$M = \frac{\sqrt{\frac{R}{n}}}{\frac{R}{n}+R} K = \frac{1}{\sqrt{R}}\left[\frac{\sqrt{n}}{1+n}\right] K$$

Now, to obtain the maximum effect we must have $n = 1$, then

$$M = \frac{1}{\sqrt{R}} \times \frac{K}{2}$$

Let us now suppose $n = 9$, we then get

$$M = \frac{1}{\sqrt{R}} \times \left[\frac{\sqrt{9}}{1+9}\right] K = \frac{1}{\sqrt{R}} \times \frac{K}{3{\cdot}3}$$

or, in other words, although we have made g but $\frac{1}{9}$th of what should be its theoretical value in order to obtain maximum sensitiveness, yet by so doing the sensitiveness has only been reduced in the ratio of 3·3 to 2. Or, again, taking the case of the Wheatstone bridge, supposing that the theoretical resistance of the galvanometer for maximum sensitiveness in making a particular test had been 900 ohms, and supposing that when equilibrium had been nearly

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but not quite arrived at, a deflection of the needle of 3·3 divisions from zero had been obtained, then if the resistance had been made 100 instead of 900, the deflection would only have been reduced to 2°. Precisely the same result is obtained if g is made nine times its proper value. It is a somewhat interesting fact that in determining the conditions for maximum sensitiveness in a very great number of tests, an equation of nearly the form first given is obtained, and an analysis made in the manner shown would yield very similar results.

The chapters on Line Testing contain a great deal of useful information, and, as a rule, are very free from the unnecessary formula which it is the fashion to overload books of the kind with, under the plea of making explanations clearer and tests more accurate.

The Indian wire gauge, which is employed in the telegraph service in India, and a table of which is given, we notice, is based on the weight per mile of the wire; this, for various reasons, is found to be a very convenient gauge.

In the chapter containing the foregoing, some interesting details are given concerning the state of efficiency of the insulation of the Indian lines and the great variation it undergoes during the day from climatic changes. Experiments made on the Hydrabad lines gave the insulation as 8 megohms per mile in the afternoon during September (S. W. monsoon); this fell to ·08 megohms per mile in the early morning, and then increased again one hundred fold as the day advanced. Considering that the lengths of the lines in India are such that, in making a test, the insulation resistances cannot be disregarded in comparison with the conductivity resistances, the difficulties in accurately localising faults from the continual variation of the insulation may well be imagined.

Attention is drawn, in the memorandum before referred to, to the addition in the book of De Sauty's capacity test. Now, we are inclined to think, from the fact of this test being given in most text books dealing with electrical testing, that it has never been made, except theoretically. Practically, the test is almost useless if any pretence to accuracy is required, the reason being that, when any approach to a balance becomes to be made, the quantity of electricity discharged through the galvanometer becomes so small, and of such extremely short duration, that *practical* balance is obtained long before *theoretical* balance is arrived at, even with a very sensitive Thomson galvanometer.

At the end of Vol. I., the system of compiling the tests is illustrated, and much valuable information is thus recorded, and that in a very convenient form.

Vol. II. of the work chiefly deals with testing and working apparatus; but, at the commencement, the testing of batteries, &c., with the tangent galvanometer, is both theoretically and practically considered, and that in a very clear manner, the conditions for making accurate tests being well examined.

The system of earth testing adopted hardly seems an entirely satisfactory one, as it practically can only show whether the resistances between the earth-plate and two other earths contiguous to them are small, and not whether the resistance between the particular station and other stations is small. If the station at which the tests were made, to take a suppositious case, stood in a rocky basin, which insulated it from the other parts of the country, the tests recommended would prove little or nothing of any value; they would prove whether the earth-plate itself were insulated, by its surface being completely oxidised or rusted (if of iron), but faulty earths are not always caused by such strictly local effects, though in many cases they are so, as is pointed out.

The local products of India seem in many cases very suitable for telegraph stores; sal-ammoniac is a common article of commerce for instance, and for cleaning the coppers and brass-work of the batteries "tamarind" water is found highly efficient.

In speaking of "double current" working, a fact not generally known is pointed out, viz., that this kind of working does not diminish retardation due to the electrostatic capacity of the line, a fallacy disposed of by Prof. Fleeming Jenkin, in a number of the *Philosophical Magazine* for 1863.

In the sections devoted to Duplex Telegraphy, the theories of the different systems are but briefly entered into, and nothing is lost by their being so treated. In comparing the "differential" with the bridge method it is shown that the former is more economical than the latter, as regards battery power, in the proportion of 4·0 to 2·4, and is less affected by variation of the line resistance in the proportion of 2·3 to 2·0. The quadruplex is also briefly explained, and a full illustrated description of Preece's railway block instruments, which are employed to some extent in India, completes the volumes, which are undeniably very useful and creditable productions.

Electric transmission of Power; its present position and advantages. By PAGET HIGGS, LL.D. London: E. & F. N. Spon.

THE scientific mind of the world is becoming awake to the fact that electricity will play an important part in the future as the swift vehicle of power. At present, very little has been done to make an economic success of electro-motive transmission; but still something has been done, and the feasibility of the process demonstrated. Dr. Higgs has, therefore, taken time by the forelock, and collected into a handy little book—we might rather say pamphlet—all the most reliable data on the subject, together with some of his own experimental results. He first describes the most prominent dynamo-electric machines, then considers the mechanical ratio of the efficiency of this mode of transmission and its applicability either to long or short distances, and finally sums up the most patent advantages of employing electricity for the purpose in hand. There are several valuable references throughout the book; but if the author had given a full list of authorities and papers on the question he would have materially assisted enquirers.

The fact, as pointed out by Professors Houston and Thomson, that electro-generators of 1,000 H.-P., as proposed at first by Dr. Siemens, are not really necessary for the transmission of power by electricity for great distances, that conductors of immense size are not required, and that some 48 per cent. of the original electric energy can be utilised for work,

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combine to make the electrician sanguine as to the promise of this method of conveying power. This percentage of reclaimed energy is more than can be obtained from compressed air, and is almost as much as can be yielded by means of hydraulic transmission.

New Patents—1879.

3368. "Joinings for wire fences, telegraph wires and continuous lengths of wires or rods for other purposes." T. YOUNG. Dated Aug. 21.

3393. "Telephones." P. S. JUSTICE (communicated by S. H. Short). Dated Aug. 23.

3410. "Electric batteries." W. MORGAN BROWN (communicated by W. F. E. McCarty). Dated Aug. 25. Complete.

3436. "Galvanic batteries." R. C. ANDERSON. Dated Aug. 26.

3472. "Improved compounds or combination of ingredients for insulating and coating telegraph wires (submarine and land). A. WILKINSON. Dated Aug. 28.

3525. "Telegraphic recording apparatus." R. K. BOYLE. Dated Sept. 3.

3543. "Improvements in electro-magnetic induction apparatus and in the means of neutralising induced currents by the aid of such apparatus." R. H. COURTENAY. Dated Sept. 3.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.—1879.

211. "Producing and applying electric currents for lighting, &c." JOHN RAPIEFF. Dated Jan. 18. 1s. 10d. This describes a new dynamo-electric machine in which non-magnetic or dia-magnetic cores are employed in the electro-magnets to lessen absorption of the magnetism. Various plans for making and arranging the electro-magnets are also illustrated with different forms of Rapieff's electric lamp.

229. "Telephones." W. R. LAKE (communicated by F. Blake, Jr., of Weston, Mass., U.S.). Dated Jan. 20. 6d. This describes a microphonic telephone transmitter having both carbon electrodes or microphone contact pieces free to move with the diaphragm, instead of only one, as usually employed. One of these is made heavy so as to offer inertia to the rapid vibrations of the diaphragm.

259. "Lamp or apparatus for shading the electric or other lights, &c." T. W. GRIEVE. Dated Jan. 22. 6d. This consists in arranging coloured or opaque glass, or other shades for electric or other lights so that they can be raised or lowered in any order. The shades are lowered by means of a cord and pulleys.

277. "Electric lighting." SIGISMUND COHNÉ. Dated Jan. 22. 4d. This consists in making electric candles of ultramarine, either pure or mixed with carbon, kaolin, plaster of Paris, molasses, or powdered metal, preferably copper. The composite candles are made into a paste, moulded, and then baked to char the molasses and sublime the sulphur. They are constant in resistance and consume slowly. To increase the conductivity of the candle it is put into a zinc tube before being baked and the baking sublimates the zinc and drives it into the candle.

299. "Apparatus for producing light by electricity." H. J. HADDAN (communicated by E. Molera and J. Celrian, San Francisco, U.S.). Dated Jan. 24. 10d. This plan for distributing electric light by pipes and lenses was illustrated in the TELEGRAPHIC JOURNAL for July 15.

307. "Insulated wires and cables." W. MOSELEY Dated Jan. 24. 2d. The wire is covered with a jacket of horse-hair saturated with melted resin or gum mixed with oil to toughen it. It is then enclosed in a double sheathing of copper or other metal with tin between the double sheath. *Not proceeded with.*

315. "Apparatus for transmitting and receiving articulate and other sounds." F. A. GOWER and CORNELIUS ROOSEVELT. Dated Jan. 25. 6d. This describes Gower's well-known telephone. See TELEGRAPHIC JOURNAL for March 1.

332. "Obtaining currents of electricity." W. B. F. ELPHINSTONE, BARON ELPHINSTONE, and C. W. VINCENT. Dated Jan. 27. 6d. This describes a dynamo-electric machine in which the lines of terrestrial magnetic force are used to assist the artificial magnetic field.

General Science.

THE SEA-MOLE AND BI-AUTOMATIC GRAPNEL.—An ingenious diving-bell, called the "Sea-Mole," was on view in the Italian section of the Paris Exhibition. It is the invention of Signor Toselli, and consists of a hermetically closed iron cabinet or bell, containing a reservoir of air. It can be steered by the diver himself, and he can descend or rise in the water with it at pleasure. Lead weights and air pipes are consequently dispensed with, but a rope in connection with the surface is necessary. It is furnished with the electric light, which the diver can set glowing. There are glass windows for him to see by, and holes to put out grapnels, to grasp kegs, boxes, and other objects on the bottom, as well as artificial hands to seize pearl oysters, sponges, shell-fish, submarine cables, or shears to cut torpedo wires.

A SCIENTIFIC PROPHECY.—The discovery of the planet Neptune, after it had been foretold by Adams and Leverrier, the realisation of Mendelejeff, the Russian chemist's prediction, that certain chemical elements existed, are well-known instances of scientific prophecy; but a more recent and not less remarkable case has occurred in Mr. Pliny Earle Chase's harmonically indicated planets. Mr. Chase, detecting a harmonic relation (foreshadowed by Bode's law) between the mean distances of the planets and the sun, was led to suspect the existence of three intra mercurial planets. His arguments were published in the *American Philsophical Society* for 1873. Now it appears that the third of these planets seems to be the interior planet lately discovered by Prof. Watson. The elements of the planet are as follows:

	Distance.	Time.
As computed by Gaillot -	·164	24·25 days.
As predicted by Chase - -	·165	24·50 ,,

The other two predicted planets remain as yet undiscovered.

A MONUMENT is to be raised to Julius Robert Mayer.

PINTSCH'S RAILWAY LIGHTS.—Mr. Julius Pintsch's system for lighting railway trains, or other vehicles, buoys, and steamers, is perhaps the most successful of

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all the plans for lighting carriages by gas. It is used on many of the German and Russian railways, the Prussian mail trains and state carriages, and has been adopted by the Metropolitan Railway Company in England. The gas employed is oil-gas, distilled from refuse petroleum or grease in retorts specially designed by Mr. Pintsch. It is compressed to six atmospheres into two holders fitted underneath each carriage. These two holders supply the four lamps necessary for the four compartments of the carriage, one jet being sufficient to light a compartment sufficiently to enable travellers to read during a night journey. The gas is supplied to the lamps by pipes through the medium of an automatic regulator, which maintains the stream of gas uniform, and thus provides a steady light whatever be the oscillations of the carriage. This regulator is an essential feature in the success of the system. It operates by means of a lever controlling a valve in the pipe, the lever being actuated by the pressure of the gas on a membrane. The burner employed is a small fish-tail; and there is a device for suddenly lowering the light in the case of trains passing through tunnels and daylight spaces alternately. Pintsch's plan gained the 1877 gold medal offered by the Society of Arts for railway lamps, and also Exposition medals at Moscow, Vienna, &c. Its economy over coal gas or oil lighting is nearly 50 per cent., and the light which it gives is superior to these methods. Oil gas is richer than coal gas, and gives 3½ times the illuminating power. In addition it does not lose its hydro-carbons so readily by compression, hence its employment by Mr. Pintsch.

MICHAUD'S PHOTOTYPES.—M. Michaud, a Parisian chemist, has succeeded in taking metallic casts from bichromated gelatine plates, directly engraved by photography. The process consists in melting an alloy of mercury and d'Arcet metal (an alloy of bismuth, tin, and lead) in a metal box, and gently impressing the graved gelatine plate face downwards on the surface of the fluid metal. When the metal has cooled again it becomes hard, and the negative can be separated from it, leaving the cast which can be utilised for blocks in typographic printing, or in lithography. Electrotypes may also be made from it for copper-plate printing.

City Notes.

Old Broad Street, Sept. 11th, 1879.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED).—The 44th ordinary general meeting of the shareholders of the above Company was held on Tuesday, August 26th, at the Cannon Street Terminus Hotel, under the presidency of Sir James Carmichael, Bart., the Chairman of the Company. The report of the directors for the half-year ended the 30th June last stated that there was a slight improvement over the previous half year, which was as much as could be expected under the protracted depression of commerce everywhere prevalent. The balance of the cost of repairing the cables referred to in the last report had entailed the necessity of applying to the Treasury for the full amount due under the guarantee. A telegraph conference had lately been held in London, at which the delegates of the various governments revised the rules and regulations affecting the international service, and determined to substitute a word tariff in Europe in place of the present system of charging the same sum for a message of twenty words, or less than twenty words. The Company's cables were in efficient working order. They recommended the payment of the usual dividend at the rate of 8 per cent. per annum on the preference stock, less income tax, and of a dividend at the rate of 3 per cent. per annum, free of income tax, on the ordinary stock, payable on and after the 1st proximo.

The revenue account stated that the receipts for messages during the half year had been £2,072, and the amount due from the Government under the guarantee was £3,600. The expenses of the offices and stations came to £1,877, the repairs of the Malta and Corfu cables to £2,140, and the amount available for dividends was £3,053.—The chairman in moving the adoption of the report, stated that he did not intend to detain them at any length, or to make any special observations, but he wish to call their attention to one subject—The Telegraph Conference. The conference was held in London, and sat for some weeks, and the Company was represented at it by their secretary, Mr. Tombs. After considerable discussion, it was ultimately decided that a general word-rate should be adopted throughout Europe. This was a great change to make, and, as regarded its effect on the receipts of the Company, it was very difficult to predict, but his individual belief was that it would be beneficial to the Company, as small traders, those interested in the fruit, vegetable, and fish trades, would be more disposed to pay fifteen centimes per word instead of, as at present, so many francs per message of twenty words.—The Hon. Ashley Ponsonby seconded the motion.—Mr. Robinson suggested that some provision should be made to prepare against the termination of the subsidy.—The Chairman said if the shareholders were willing for this purpose to forego 50 per cent. of their dividend, the Board would have no objection. They would consider the proposal between this and next meeting. The report was then adopted, and the dividends recommended declared. The retiring directors, Mr. Gurney and Captain A. T. Hamilton, were re-elected, as were also Messrs. Allwright and Robinson, the retiring auditors, and the proceedings then terminated in the usual manner.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 52¾-53¼; Ditto, Preferred, 81¾-82¼; Ditto, Deferred, 26¼-27¼; Brazilian Submarine, Limited, 6¾-7; Cuba, Limited, 7¼-8; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 11¼-11¾; Direct United States Cable, Limited, 1877, 10¼-10½; Eastern, Limited, 7½-8; Eastern, 6 per cent. Debentures repayable October, 1883, 105-108; Eastern 5 per cent. Debentures repayable August, 1878, 101-103; Eastern, 6 per cent. Preference, 11⅞-12⅜; Eastern Extension, Australasian and China Limited, 7¾-8; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, par 1 pm; Ditto, registered, repayable 1900, par 2 pm; German Union Telegraph and Trust, 7¼-8; Globe Telegraph and Trust, Limited, 4¾-5; Globe, 6 per cent. Preference, 11-11¼; Great Northern, 8¼-8½; Indo-European, Limited, 21-22; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9-9¼; Reuter's, Limited, 9-10; Submarine, 222-227; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1¼-1½; Ditto, 6 per cent. First Preference 7-7¼; Ditto, ditto, Second Preference, 6¾-7¼; Western and Brazilian, Limited, 3-3¼; Ditto, 6 per cent. Debentures "A," 94-98, Ditto, ditto, ditto, "B," 87-92; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 118-122; Ditto, 6 per cent. Sterling Bonds, 104-106; Telegraph Construction and Maintenance, Limited, 31-31¼; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2¼-2¾; India Rubber Co., 12-12½; Ditto, 6 per cent. Debenture, 103-108.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THE TIDE AS A MOTIVE POWER.

Next to the electric light, the subject which is likely to create a stir in the electrical and engineering world is undoubtedly the transmission of power to a distance. As yet the importance of the question seems hardly to be grasped, though there are signs of a movement to bring the idea prominently forward. The remarkable paper read by Professor Ayrton before the British Association has given another kick to the ball which has hitherto rolled but sluggishly.

The importance of the solution of the general problem of the transmission of power to a distance cannot be exaggerated. Once fairly set on foot, we may look with equanimity upon the exhaustion of our coal-fields. The solution of the problem means heat, light, and every other form of energy obtained in inexhaustible quantities and at any locality. The use of the tide as a motive power has been often suggested, but practically nothing has been done in this direction, and the reason, we think, is not far to seek. The mountain cannot come to Mahomet, but neither can Mahomet go to the mountain. In other words, we cannot bring our manufactories to the coast to utilise the motive power of the sea, and as yet no practical means has been devised for conveying this power inland. But, although the conveyance of power is of primary importance in carrying out the idea of utilising the energy of the tide, yet a great deal may be done, we think, in the direction of employing the tide to illuminate many of our seaport towns and watering-places, also to illuminate our lighthouses, the means being, of course, a dynamo-electric machine turned by an engine worked by the daily rise and fall of the tide. Many difficulties lie in the way of the accomplishment of the task which are so self-evident as to hardly require enumerating. The method—which we believe is still in use—of filling reservoirs at the rise of the tide, and allowing these to empty themselves at the fall, and by this means to turn a water-wheel, requires considerable space, and waste land does not abound in England. It is true this necessary space could be obtained by forming artificial reservoirs off the shore, but such constructions must necessarily be expensive. Practically, the question will undoubtedly in future resolve itself into one of expense; the means of effecting the objects in view are rapidly approaching practicability. How are these means to be so shaped that the financial aspects of the question may be favourable? The answer to this question has yet to be worked out, and we hope again to refer to it.

NOTE-BOOK PROOFS OF INVENTION.

In the American *Journal of the Telegraph* for September 1st, there is a letter from Mr. W. F. Jones, of Chicago, claiming priority of invention for Muirhead and Winter's Quadruplex System. A sketch of the system of Mr. Jones, dated June 7th, 1877, is also given and witnessed to by another gentlemen, a Mr. C. H. Wilson, whose handwriting is reproduced in fac-simile for the purpose, we suppose, of the better convincing an incredulous world of its authenticity. Now, so far from anticipating the Winter double-tongued relay by his 1877 device, if Mr. Jones and those interested will turn to the *Telegraphic Journal* for October 15th and November 15th, of the year 1875, they will find there a description of this relay by Mr. Winter himself, in a series of articles on duplex and quadruple telegraphy.

Having thus disposed of the somewhat rash claim of Mr. Jones we would willingly say no more, if it had not been that such trumpery proofs of certain American electricians have been far too common of late. Even in the same journal there is one more appropriating the credit of the new French Heraud battery to another American. The time has come to expose the hollowness of these pretensions, which are mostly put forward, we believe, by ill-versed operators, and not by truly scientific American electricians. If the thing goes on, the proverb, "That there is nothing new under the sun," will require a powerful exception in the case of the United States, for it would seem that everything new comes from there. It will soon become impossible for a European electrician to invent anything which has not been known to the Yankees for a generation at least. Should any Englishman hit upon a method of squaring the circle or cutting green cheese from the moon, and fondly believe that he has immortalised his name, he will soon be grievously disillusioned, for the next American mail will present him with one or more letters and fac-simile documents, duly attested and sworn to, each alleging that the circle had been squared by So-and-so, or lunar cheese first potted by Thingamy, in that go-ahead country exactly Such-a-date before.

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When it is considered that if this mischievous method of trying to gain the credit of an invention is tolerated, no man's original work will be safe, since it is in the power of any upstart to dispute it by fictitious proofs of this kind, it will be admitted as a working principle that only *publication* to the world should determine the authorship of an invention. We are far from meaning to imply that the American scratch claims in question are not genuine; thus far we believe they are, but the system is a pernicious one, and there is no saying to what evils it might lead if it be not nipped in the bud.

BLAKE'S MICROPHONE TRANSMITTER.

THE form of microphone designed by Mr. Francis Blake of Preston, Massachusetts, and recently introduced into this country by the Telephone Company as a transmitter for working their Bell telephone lines, is, perhaps, the most successful practical microphone which has yet been put together.

In all, or nearly all the microphones hitherto constructed one of the contact pieces is kept in a fixed position, while the other, being free to move to some extent, is constantly held in contact with this fixed piece, and is pressed against it with greater or less force by the vibrations of the diaphragm with which it is connected. In using an instrument of this form it has been found necessary to adjust the initial static pressure between its contact pieces or electrodes with great delicacy and care, in order to secure such a variation of resistance between them under the vibrations of the diaphragm as will enable the current to reproduce in a receiving instrument the sounds which fall upon the transmitting instrument. When such an adjustment has been secured it is easily disturbed by slight causes, such as a change in the temperature of the instrument or a trifling movement of some of its parts in relation to other parts.

By Mr. Blake's arrangement the proper adjustment is, however, easily secured, and is not liable to be disturbed in the practical use of the instrument. Both electrodes are supported in such a manner that they can move freely with the diaphragm. One of them may be attached directly to and be supported by the diaphragm, although it is preferred to support it in contact with the diaphragm from an independent support. The other electrode is so supported as to move freely, but is made so heavy, or is so weighted, that by its inertia it will offer a resistance to the slight and quick vibrations of the diaphragm, which will give a varying pressure between the electrodes and a consequent change in the resistance of the circuit. This second electrode is so supported that the initial static pressure between the two will not be sensibly affected by a change of temperature within the ordinary range of temperatures to which such instruments are exposed. It is placed on the end of a spring whose other end is connected to a lever, by means of which the proper initial pressure between the electrodes and against the diaphragm is obtained.

To secure contact between the electrodes, independently of the pressure against the diaphragm, the electrode next to the diaphragm is supported upon a spring which exerts its pressure against the opposite electrode.

The following drawings fully illustrate the apparatus: Fig. 1 is a plan of the mechanism attached to the top or cover of the box containing the microphone. Fig. 2 is a section of the box and mechanism on the line x, x, Fig. 1, and shows one of the terminals for making connections with the exterior circuits. Fig. 3 is a transverse section of the said box and mechanism on the line x^1, x^1, of figs. 1 and 2, and showing the terminals for making connections with the exterior circuits. On each of these figures A represents the box or casing in which the microphone is enclosed; the latter being for convenience attached to the cover or top A^1. B represents a metal ring or frame for holding the mechanism of the microphone. It is screwed to the cover A^1, as shown, and has two ears B^1, B^2. On the inner surface of the ring B is a narrow ledge or lip b, fig. 3, on which the disc or diaphragm C is placed. This diaphragm is formed as usual of a thin iron plate. A lining of paper or other suitable material is placed between it and the ledge or lip, and it is held in place by two springs D, D, attached to the metal rim or ring B, with their free ends pressing upon the back of the diaphragm near its centre so as to hold it against the ledge. Thin pads of india-rubber a, a, are placed between the ends of the springs and the diaphragm. By this method of holding the diaphragm in place it is less liable to be distorted by a change of temperature than when held wholly at its circumference. The centre of the ring and diaphragm is opposite the orifice E, fig. 2, in the cover A^1, through which the sounds enter the instrument. On the other side of the diaphragm and at its centre is placed one of the electrodes. It is a small metal bar or hammer e, fig. 2^1, one end of which rests against the said diaphragm. The other end is brought nearly to a point and is in contact with the other electrode e^1. It is desirable that it should be formed of or plated with some metal like platinum or nickel which is not easily corroded. It may be attached directly to the diaphragm, but, as stated above, it is preferred to support it independently, as shown, upon a light spring c, which tends to press it away from the diaphragm and towards the opposite electrode e^1.

This method of supporting the electrode e ensures its contact with the other electrode under some circumstances which otherwise would be liable to separate them and break the circuit.

The electrode e^1 is fastened to a weighted spring d, supported on an adjusting lever F by which the tension of the spring is regulated. This spring must be stronger than the spring c which supports the electrode e, and from its greater strength it tends to keep the electrode e in contact with the diaphragm. It may be made of a piece of a common watch-spring, and carries at its free end a weight g heavy enough to check very greatly the rate of vibration of the spring. This weight may be of metal, which may serve directly as the electrode, but better results are obtained by applying to

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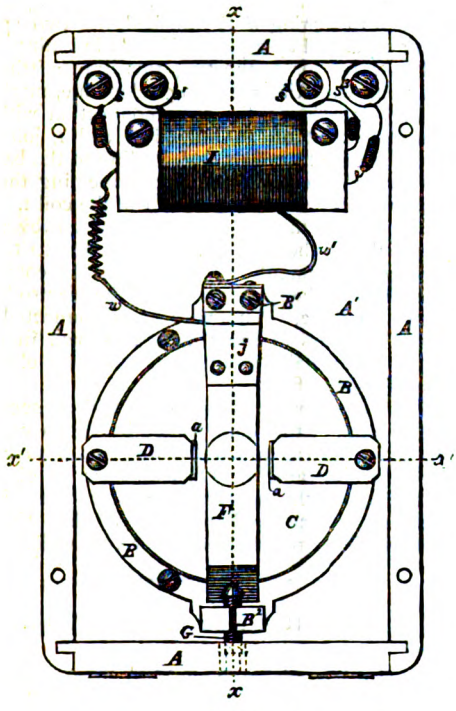

FIG. 1.

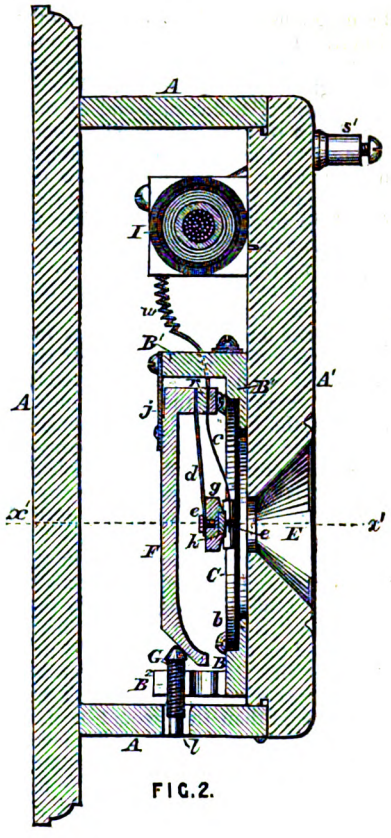

FIG. 2.

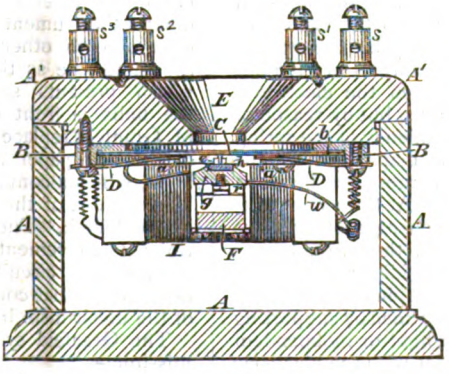

FIG. 3.

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it, at the point of contact with the other electrode, a piece of gas-coke, or a hard-pressed block of carbon *h*, such as is used in electric lighting. If the weight is a non-conductor, there must be a metallic conductor between the carbon or other electrode used and the spring or some other part of the circuit. The weight must be proportioned to the stiffness of the spring, a stiff spring requiring a heavier weight than a weaker one. The adjusting lever F, to an arm of which one end of the spring *d* is attached, is a stiff bar connected at one end by a stiff spring *j* to the ear B^1 of the ring B. The other end rests upon an adjusting screw G, placed in the ear B^2 on the opposite side of the ring. The spring *j* tends to force the lever F away from the diaphragm and against the adjusting screw G. The ear B^2, supporting the adjusting screw G, is drilled and slotted as shown in figs. 1 and 2, to prevent the screw from wearing loose.

The part of the lever F which comes in contact with the screw is inclined to the axis of the screw, as shown, so that when the screw is forced inward it will press the lever towards the diaphragm, and when it is withdrawn, the lever will, by the tension of the spring *j*, be forced away from the diaphragm. The outer end of the screw extends into a hole *l* through the casing, and is fitted to receive a key by which it can be turned to adjust the lever to a desired position.

The pressure between the two electrodes and against the diaphragm obviously depends upon the position given to the adjusting lever by the adjusting screw G, but it is evident that, as this pressure can be increased or diminished only by increasing or diminishing the tension of the spring *d*, the changes in the pressure by turning the screw will be much less rapid than they would be if the electrode were acted upon directly by the lever or the adjusting screw. Hence a proper adjustment of the initial static pressure between the electrodes can be much more easily obtained through the agency of the spring *d* than without it. It will also be seen that this pressure will not be sensibly affected by any slight change in the position of the electrodes which might arise from the expansion or contraction of any part of the apparatus under a change of temperature. On the other hand, it will be seen that if the diaphragm is thrown into the rapid but slight vibrations caused by sounds, the spring alone would yield to them so readily as to give but little change of pressure between the electrodes within the range of the vibrations, but by reason of the inertia of the weight, the tendency of the spring to follow the vibrations of the diaphragm will be checked, and a greater range of pressures between the electrodes will be obtained. At the same time, it will be readily seen that the changes of pressure will be very different from what they would be if the electrodes were supported rigidly and could not yield to the movements of the diaphragm.

An additional improvement is gained by supporting that electrode on the aforesaid light or independent spring, which keeps it in contact with the electrode e^1, for it not unfrequently happens, when the intermediate electrode is attached directly to the diaphragm, that a too rapid vibration of the diaphragm, or some other disturbance in its vibrations, will throw the outer electrode out of contact with the intermediate electrode, and thus break the circuit; but in this construction such irregular vibrations of the diaphragm will separate the diaphragm from the intermediate electrode *e* rather than separate the two electrodes from each other, and the circuit will not be broken.

For convenience in construction when employing the independent spring *c* for the purpose stated, it is attached to the same arm of the adjusting lever F, to which the spring *d* is attached, the two springs being separated by a piece of insulating substance *r*.

The wires for connecting this transmitting instrument with the receiving telephone, marked *w* and w^1, are shown, fig. 1, in connection with the primary circuit of an induction coil 1, joined to which are the terminals *s*, s^1, leading to the battery, while s^2, s^3, are terminals for connecting the line wires with the secondary circuit of the coil 1.

The use of the induction coil is, however, not essential, and the wires may go at once to the receiving instrument. The wire *w* is connected directly with the spring-arm *c* of the electrode *e*, as shown in fig. 2. The wire w^1 is connected with one of the ears of the ring B, as shown in fig. 1, which is in metallic connection with the electrode e^1, as shown in fig. 2.

From the above description it will be seen that every detail of this contrivance has been carefully worked out, so as to contribute to the success of the entire instrument. Only one carbon electrode is employed, the microphonic joint consisting of metal on the one hand and coke on the other, but two metal electrodes also answer very well.

THE HUGHES' PERFECTOR.

THE multiple telegraph of M. A. E. Granfeld, the Austro-Hungarian Commissioner of Telegraphs, and called by him the "Hughes' Perfector," has been working since last year between Vienna and Prague.

It is a combination of the Hughes and Meyer apparatus, uniting the distributor and marking helix of the latter to the printing mechanism and corrector of the former; but the distinguishing feature of Granfeld's invention is the way in which these different instruments are kept mechanically independent of each other. The Meyer shaft placed on the same axle as the index of the distributor, and which presents successively a different part of the helix in front of each printer, is suppressed. M. Granfeld replaces it by disposing over each band of printing paper a cylinder carrying a complete helix, which a contact, made at the proper moment by the index of the distributor, throws out of gear by clockwork. The cylinder stops at each revolution: its movement commences a little before the printer is in circuit with the line, and finishes a little before that communication is broken, the play of the mechanism being regulated in consequence.

The Granfeld system comprises, for four transmissions—

1. A principal distributing apparatus.
2. Four auxiliary apparatus.

The principal apparatus or distributor is an ordinary Hughes, to which is added an index fixed to the type-wheels in such a way as to follow their movements of rotation and correction. This index turns

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in front of a disc or dial of ebonite, divided into four zones, each comprising metallic pieces connected to the different organs of the system. Four rubbers fixed upon the index, at different distances from the point of rotation, traverse these zones, on which they lightly press. These rubbers, insulated from the index, are connected *two by two*, and put into connection, the first zone with the second, and the third with the fourth. This last, the fourth and most eccentric, comprises 67 contact pieces, separated by a small insulating interval, and arranged as in the Meyer distributor. The three first pieces serve for the correction, the other 64 are divided into four series of 16. The pieces of each series are connected to the "receiving relay" of an auxiliary apparatus, either directly or by the medium of the key, as will be described later on.

The third zone comprises only a circular metal piece connected directly to the wire of the line. The rubbers which travel over the two zones (the fourth and third) being united, each turn of the index puts the line in contact with the metal pieces serving for the correction, and then successively with the metal pieces connected to the diver's apparatus.

The second zone of the disc is, like the third, formed by a metal ring, and is connected to one of the poles of a local battery.

Lastly, the first zone comprises four contact pieces conveniently spaced and connected to the second pole of the local battery; an electro-magnet is intercalated between each of these pieces and this pole. These four electro-magnets are called the electro-magnetic *embrayeurs* or dislocators of the auxiliary apparatus. The position of the contact pieces of this last zone is such that the circuit local battery, including the electro-magnetic "embrayeur" of an auxiliary apparatus, is closed a little before the rubber of the fourth zone attains the series into connection with the receiving relay of the same apparatus.

Synchronism is established between the two corresponding distributing apparatus at the sending and receiving stations. At each turn of the index a current, sent automatically into the line, by one of these apparatus, traverses the electro-magnet of the second apparatus, and maintains synchronism in the same way as in the ordinary Hughes. For this purpose the three connecting plates of the distributor which should receive the current are connected to the electro-magnet of the Hughes by this distributor, and the correcting plates of the other apparatus are in communication—the middle one with the line battery, the other extreme two with the earth. A commutator permits of modifying these communications according as it is desired to give or receive correction.

Each of the auxiliary apparatus comprises a clockwork in movement during all the time of working, its speed being regulated by a vane or a vibrating stem. An electro-magnet (electro-embrayeur) placed in the circuit of the local battery connected to the first and second zone of the distributor, throws off, when the circuit is closed, an axle carrying a cylinder about four centimetres long, on the surface of which is cut in relief a helix, of which the pitch is the same length.

Like the printing axle of the Hughes, the cylinder after each revolution stops until a new current comes to put it in motion.

Under the cylinder is placed a band of paper, which is projected against the helix by a second electro-magnet (or electro-printer). This electro-magnet is acted on by a relay which receives the incoming current of the line. The signals are, as in the Meyer, printed across the paper, which advances a few millimetres the instant after the helix completes its revolution.

Each auxiliary apparatus, or printer, is furnished with a manipulating key composed of ten finger-pieces, five black for dots, and five white for dashes. Each finger-piece, like the Morse key, is made of three parts—the lever, the rest contact, and the "make" or anvil contact. The lever is connected to the line through the distributor, the rest contact to the receiving relay, and the anvil to the battery. It results from this arrangement that on pressing a finger-piece the receiving relay is insulated; but in order to record the message at the sending station, a second relay (sending relay), is intercalated between the anvil of the key and the battery. This relay, at each emission of the line current, closes, like the receiving relay, the current of a local battery acting on the electro-printer. M. Granfield has employed two relays in order to avoid difficulties of regulation in a relay working, which would require to work well with currents of two different strengths.

To sum up, each auxiliary apparatus comprises:—

1. A clockwork.
2. A sending key.
3. An electro-magnetic dislocator.
4. An electro-magnetic printer.
5. A sending relay.
6. A receiving relay.

We have seen that the fourth zone of the disc of the distributor is composed, besides three pieces for correcting, of four series of sixteen pieces, each piece of the same series being connected to the receiving relay of the auxiliary apparatus, either directly or through the key.

The details of the communications of the sixteen pieces, in the order of their traverse by the rubber, are as follows:—

The first piece is connected directly to the relay.
The second piece is connected to the lever of the first black finger-piece.
The third piece is connected to the lever of the first white finger-piece.
The fourth piece is connected to the relay.

. . . . . .
. . . . . .

The fifteenth piece is connected to the lever of the fifth white finger-piece.
The sixteenth piece is connected to the relay.

Thus, on pressing the first black finger-piece (dot) of the first auxiliary apparatus, the operator puts the second metallic piece of the first series of 16 pieces of the disc in connection with the line battery. When the rubber of the fourth zone traverses that second piece, it sends into the line a current equal in duration to that which is made to traverse it. On pressing the white finger-piece (dash), the operator puts into communication with the line battery not merely the metal piece of the disc (dash) which corresponds to that piece, but also the metal piece (dot) which corresponds to the preceding black finger-piece. This result is brought

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about by a special arrangement of the manipulator already employed by M. Meyer.

At the corresponding station, the current coming from the line, arrives at the metal ring of the third zone, passes by the united rubbers to the pieces of the fourth zone, and actuates the receiving relay of the auxiliary apparatus in connection with the pieces of that last zone. The current passes from the fourth zone to the relay, either directly or through the manipulator, according as the pieces traversed during emission are connected to the relays or to the finger-pieces of the key.

Representing the time occupied by the index in making one turn round the dial or disc by T, and leaving out the pieces for correction, each series of the fourth zone will be traversed in $\frac{T}{4}$ time.

We have seen that at each auxiliary apparatus the cylinder carrying the helix was put in movement a little before the arrival of the index on the series which corresponds to it. M. Granfeld has fixed for this interval of time about $\frac{T}{8}$. The speed of the clockwork of the auxiliary apparatus is otherwise regulated so that the cylinder carrying the helix may make one revolution in $\frac{T}{2}$: this cylinder finishing its revolution $\frac{T}{8}$ after the needle has quitted the corresponding sector. Each printer is consequently ready to receive the signals intended for it during all the while the index of the distributor traverses its particular sector; variations of speed only have the effect of lengthening out or shortening the signals on the paper band.

For these auxiliary apparatus M. Granfeld has utilised certain Hughes' movements, which he has modified in such a way that at each unlockage a special shaft, carrying the cylinder, makes a revolution in about $\frac{1}{3}$ second, the index of the regulator traversing the dial in about $\frac{2}{3}$ second.

The Granfeld apparatus working between Vienna and Prague has given good results, with a speed of 88 turns of the regulator per minute, giving $(88 \times 4 \times 60) = 21{,}120$ letters, or a mean of 3,520 words per hour. By suppressing the fifteenth white and black finger-pieces, it would be possible to serve five apparatus instead of four, and increase the total efficiency in proportion.

It should be added that, by an easy manœuvre, the operator can raise the disc placed in front of the index, and utilise the principal apparatus as an ordinary Hughes. — SAMBOURG in the *Annales Télégraphiques.*

THE TELEGRAPH IN CHINA.

THE line from Tientsin to Taku, a distance of some forty miles, was opened for the transmission of public messages on June first. The line was erected by the students of the Imperial Torpedo College, of which Mr. J. A. Betts, M.S.T.E., is Director. The working staff, both engineering and commercial, is entirely Chinese. Direct working Morse instruments are employed, and a fair amount of business is being done, the receipts for the first month exceeding the estimated amount. The charge for a message of ten words is fixed at one dollar. Messages may be written in either English or Chinese. Not the slightest opposition has been offered by the people to the erection or working of the line, although it passes through the neighbourhood of several camps of turbulent soldiery. The thanks of the foreign community are largely due to H. E. Di Hung Chang for his enlightened policy in throwing the line open, and thus setting the example of erecting the first public telegraph line in China built and maintained by Chinese. It speaks something also for the success of Mr. Betts' experiment that, in the short space of three years, he has been able to educate an efficient staff of telegraphists in addition to the chief work of the college—viz., torpedo engineering.

THE BELGIAN TELEGRAPH SERVICE.

FROM the report of the Director-General on the telegraph service of Belgium for the year 1878, we learn that for several years the increase of telegraphic correspondence in Belgium has been almost arrested. In 1877, for the first time, the number of private messages fell below that of the preceding year, and although the results for 1878 exceed even those of 1876, there are as yet no signs of the revival of trade from which much is expected.

Out of 1,966,473 messages exchanged between Belgian offices during the year there were 55,326 "urgent" messages, 74 repeated messages, and 122 acknowledgments of receipt. "Urgent" telegrams, securing priority of transmission by means of a higher charge, have been accepted in Belgium for twenty-three years without causing any objection or inconvenience whatever. The charge for urgency was at first fixed at three times the ordinary rate. It was afterward thought prudent to charge a quadruple rate, but in 1869, after three years' experience, it was found possible to transmit these messages at double the ordinary charge. The double rate is obligatory for telegrams handed in after nine in the evening for transmission during the night, 7,529 out of 55,326 "urgent" messages being thus charged. This class of telegrams during the day comprises but 2½ per cent. of the whole traffic, which small proportion is explained by the nearness of the towns to each other, the large number of railway lines, the rapidity of the postal communications, and the large number of deliveries.

About half of the urgent messages sent occupy less than ten minutes in transit between the sender and receiver, a large number of these telegrams being exchanged between the Brussels and Antwerp bourses at hours when the correspondents are within a few steps of the instruments. This instance shows the practical utility of priority in virtue of the higher charge. If the correspondents who direct their operations by means of questions and replies exchanged in ten minutes had to wait their turn, they would often be unable to avail themselves of the telegraph. This deprivation would not profit any one, for, in the proportion in which they exist, "urgent" messages do not cause an appreciable delay to the ordinary correspondence. Repetitions can be obtained for 25 centimes—5 cents—and it is a striking proof of the accuracy of the service that it is only demanded once for every 40,000 messages. It is very rare that a despatch is completely lost in course of transmission. Nevertheless, this does occasionally happen, and no telegraphic service can offer absolute guarantee against non-delivery from this cause. The only safeguard lies in the acknowledgment of receipt.

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Although in Belgium this costs half a franc—twice as much as repetition up to thirty words—it is demanded six times in 100,000 messages—no doubt as much as a check upon the correspondent as upon a telegraph service.

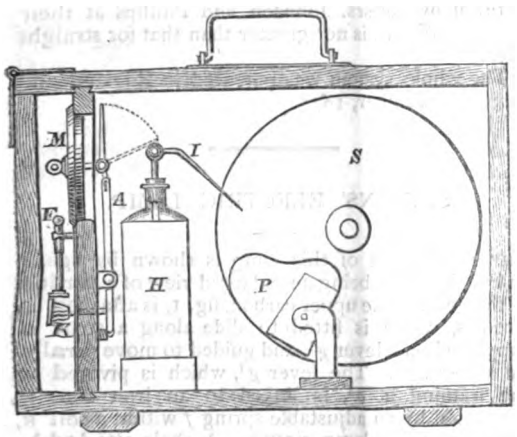
Telegraphic remittances, at charge of 1f.—20 cents—acknowledgment of receipt included, in addition to the postal rate, numbered 14,846 during 1878.

In the four principal cities (Brussels, Antwerp, Ghent and Liege) a letter or post-card bearing, in addition to the postage stamp, a five cent telegraph stamp, is delivered express by means of the service of messengers organized for the distribution of telegrams. This service is conducted in a certain number of fixed posts connected by tramways. The letters and cards are received at all postal and telegraph offices, and may be deposited in special boxes provided on the cars. This service dealt with 51,285 letters and 48,467 post-cards in 1878, the receipts to the credit of the Telegraph Department being 24,938f.—about 4,900 dollars.

On December 31st last, Belgium had 648 offices, and worked 1,161 instruments. The Morse instrument is in general use in all the offices, with the addition in the principal towns of the Hughes printer. A few offices work the A B C instrument. There are 1,143 Morse, 48 Hughes, and 10 A B C instruments in use. The total number of persons employed in the telegraph service was 3,685.

AN ELECTRIC EXPLODER.

MANY practical men, even intelligent ones, wrongly suppose that it is necessary to employ dynamic electricity for all the great effects of modern industry. It will not be out of place to show that frictional electricity can be usefully employed in

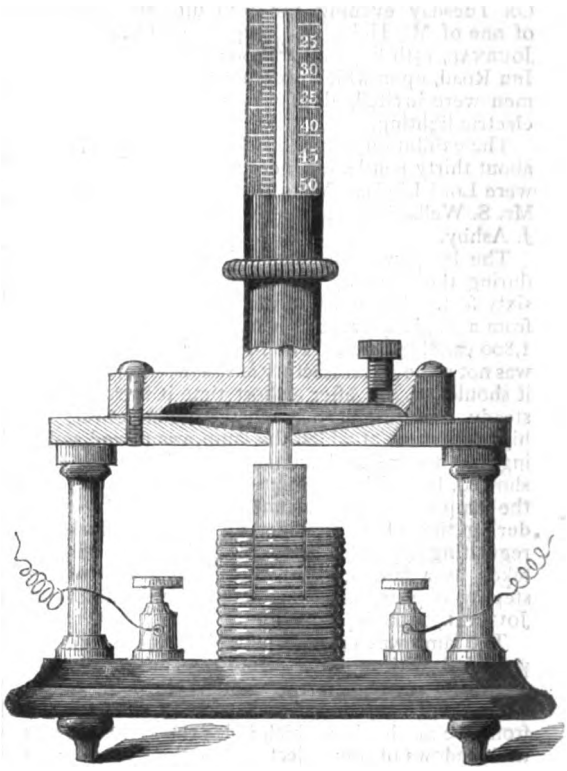


many cases, and that the works of old electricians—those fathers of a science so grand and so progressive—have not been set aside by the most marvellous progress that history can record. One of the best ways to fire fuses in mines, in which the explosive material is the dynamite of Nobel, is by means of the apparatus of M. Vian, 12, Rue Condonet. This arrangement is formed of two discs of resin, to which are given a rotatory movement by means of a handle. These discs, S, in their movement of rotation, rub between cushions covered with cat-skin, P.

The electricity thus developed is taken off by the point I, which communicates with the interior of a Leyden jar, which acts as a condenser. The exterior coating H of the jar is connected with the point situated at a distance at which the spark is to be produced. But a difficulty arises in the employment of this apparatus. The discharge which is produced is scarcely ever complete; it remains on the two surfaces of the Leyden jar; in other words, it is a residual charge. The parts shown on the left of the figure form the discharger, the object of which is to cause a spark to jump between the metallic pieces F and M. This result is obtained by pressing the button K, so that the movable lever which terminates the part A comes into contact with the knob of the Leyden jar.—*L'Electricité.*

HOPKINS' ELECTRIC CURRENT MEASURER.

THIS instrument, devised by Mr. G. M. Hopkins of the United States, America, is shown by the figure. It consists of a vulcanite chamber, to which



is fixed a glass tube of small calibre; a steel diaphragm runs across the chamber, and the space above it is filled with mercury.

A vulcanite screw at the top of the chamber

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serves to adjust the height of the mercury in the tube. The graduations on the scale at the side of the tube represent the number of pounds of attractive force exerted on the instrument. The graduations from zero upward indicate the degree of upward pressure when the force of repulsion is measured.

A short rod is attached to the middle of the diaphragm, and projects downward through a hole in the base plate to receive a cylindrical armature or core which extends into a helix.

The diameter of the diaphragm is 2 inches; the calibre of the glass tube, 0·2 inch; therefore a very slight motion of the diaphragm is indicated by a considerable movement of the mercury in the tube.

When the repelling force of a magnet is to be exhibited the soft iron armature is replaced by a permanent magnet.

The instrument shown by the fig. may be placed anywhere in a circuit, and will indicate the strength of the current. An increase in electro-motive force results in the drawing in of the iron core and a consequent deflection of the diaphragm and movement of the mercury column.

HEINRICHS' ELECTRIC LAMP.

ON Tuesday evening, the 16th ult., an exhibition of one of Mr. Heinrichs' lamps (see TELEGRAPHIC JOURNAL, 15th September) took place at 80, Gray's Inn Road, upon which occasion a number of gentlemen were invited, all of whom take an interest in electric lighting.

The exhibition commenced at eight o'clock, when about thirty gentlemen were present, among whom were Lord Lindsay, M.P., Mr. Spottiswoode, F.R.S., Mr. S. Wells, Mr. E. Cox, Mr. F. Flower, and Mr. J. Ashby.

The lamp was suspended in the open air, and during the evening was raised to an elevation of sixty feet. The current was supplied to the lamp from a single current dynamo-machine of 1,200 to 1,800 candle power. The light in the first instance was not quite as satisfactory as the inventor intended it should be, but after a short time it became very steady, and produced a most brilliant effect, the high elevation at which the lamp was placed showing this to great advantage. Mr. Heinrichs then showed, by quick interruptions of the current, that the lamp was always instantaneously re-lighted, and during the whole evening, up to ten o'clock, the regulating apparatus acted perfectly, which may be taken as a fair proof of the practicability of the step-by-step feeding arrangement (see TELEGRAPHIC JOURNAL, 15th September).

The lamp was covered by a glass globe, and was provided with a large white japanned reflector, 36 inches in diameter. A noticeable point in the illumination was the absence of the usual shadows from the mechanism which holds the carbon, whilst the shadows of any objects upon the ground were remarkable for their absence of sharpness of outline.

All the visitors seemed to be very much satisfied with the favourable results obtained with this new lamp, which prognosticated for the system an extensive employment.

There has been a great want of a simple form of electric lamp for lighting up railway stations, churches, or large public halls, which will burn steadily for a long period, and as the Heinrichs' lamp will last for ten to twenty-four hours, without change of carbons, it may prove a dangerous competitor to other systems in use.

Mr. Heinrichs also showed his new electric-motor, which gave most favourable results as a transmitter of power, and which we hope to describe in detail at some future time; at present we will give only a few notes of the results obtained with this motor during the evening.

The current of a Gramme machine driven at 850 revolutions per minute by 1½ to 2 horse-power, was connected by sixty yards of cable to Heinrichs' electric-motor. The revolving armature of this motor weighs over forty pounds, and was driven by the current at a rate of 1,600 revolutions per minute. The motor was then connected by a belt to a grindstone 30 inches in diameter and 4 inches wide; the grindstone was then driven by the motor at a speed of from 230 to 250 revolutions per minute, whilst the motor kept up a speed of 1,100 revolutions per minute. When rough work was put in operation upon the grindstone the speed of the latter was but little reduced. It is stated that the loss of power in this motor, worked by a dynamo-machine at a distance of 60 to 100 yards, was not 20 per cent.

Mr. Heinrichs promises to have in a short time a new single current dynamo-machine for light purposes, and will then be able to give more exact figures as to the illuminating power of his light and how much power is lost by the transmission of power by his new electric-motor, which must be very favourable according to the results obtained.

We are informed by Mr. Heinrichs that the expense of the circular carbons, which were manufactured by Messrs. Johnson and Phillips at their Charlton Works, is not greater than that for straight ones.

The whole system was patented in England and abroad November, 1878.

SIEMENS' ELECTRIC LAMP.

THE mechanism of this lamp is shown by figs. 1 and 2, the latter being an enlarged view of a portion of the gear. The upper carbon, fig. 1, is attached to a rod S, which is fitted to slide along a stem A, supported on a lever g^1, and guided to move parallel by a radius g. The lever g^1, which is pivoted to the framing at o^1, is linked to an iron core E, supported by an adjustable spring f within a coil R, which is in the lamp circuit. A chain attached to the lower end of the slide S passes over a wheel r, having teeth to engage its successive links. The wheel r is mounted on the stem A, and is prevented from turning by a pawl z catching in the teeth of a ratchet wheel on the axis of r. So long as z remains engaged with these teeth, the slide S and the stem A remain firmly connected, both moving together in obedience to the movements of the core E, which rises as the electrical force increases, and descends as it diminishes. By these movements

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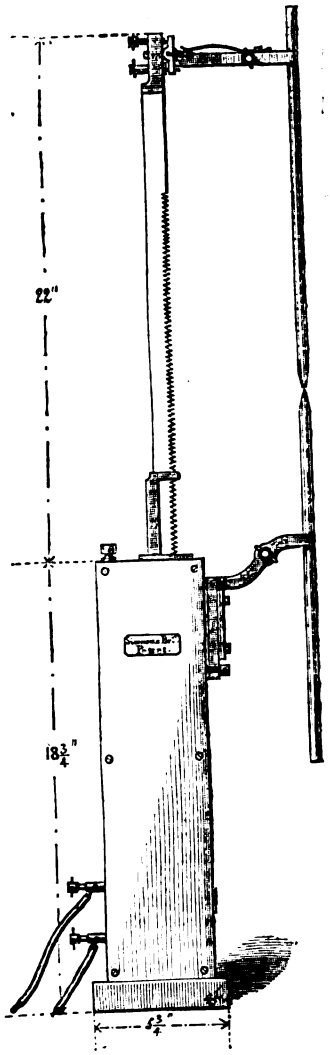

FIG. 3.

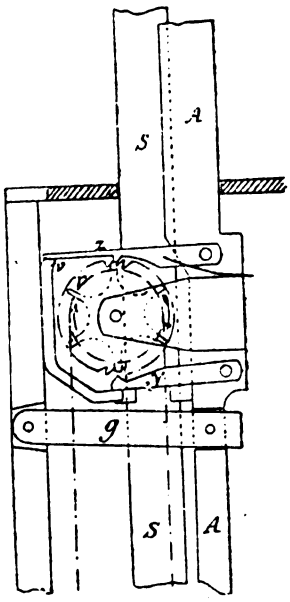

FIG. 2.

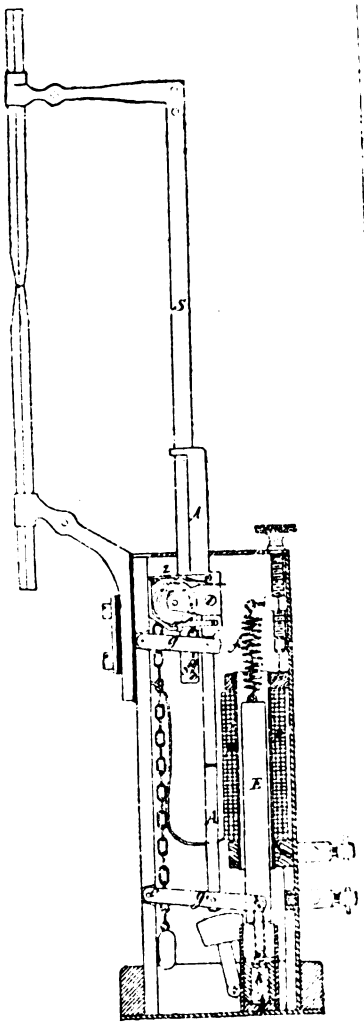

FIG. 1.

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the distance of the carbon points is automatically adjusted. When, however, the carbons become so far consumed that the stem A has to descend to its lowest point, in order to bring the carbon points sufficiently near for the passage of the electrical current, then the pawl *z*, catching on a fixed projection *v*, is lifted out of gear with the teeth of *r*, and the wheel being then free to revolve in the direction of the arrow, the slide S with the upper carbon descends relatively to the stem A sufficiently far to make up for the consumption of the carbons. To prevent the sudden descent of S, another pawl *y* is provided to catch the teeth of *r*, like the anchor of an escapement, so that the wheel *r* can only turn intermittently one tooth at a time. The movements of the core E are damped by a piston *x* working in an air cylinder. Fig. 3 shows a general view of the lamp.

HEATING METALS IN VACUO BY THE ELECTRIC CURRENT.

A VERY interesting paper, by Mr. T. A. Edison, was read before the American Association at Saratoga the other day:

"In the course of my experiments on electric lighting," says the author, "I have developed some striking phenomena arising from the heating of metals by flames and by the electric current, especially wires of platinum and platinum alloyed with iridium. These experiments are still in progress.

"The first fact observed was that platinum lost weight when heated in a flame of hydrogen, that the metal coloured the flame green, and that these two results continued until the whole of the platinum in contact with the flame had disappeared.

"A platinum wire, twenty-thousandths of an inch in diameter was wound in the form of a spiral one-eighth of an inch in diameter and half an inch in length. The two ends of the spiral were secured to clamping posts, and the whole apparatus was covered with a glass shade. Upon bringing the spiral to incandescence for twenty minutes that part of the globe in line with the sides of the spiral became slightly darkened; in five hours the deposit became so thick that the incandescent spiral could not be seen through the deposit. This film, which was most perfect, consisted of platinum, and I have no doubt but that large plates of glass might be coated economically by placing them on each side of a large sheet of platinum, kept incandescent by the electric current. This loss in weight, together with the deposit upon the glass, presented a very serious obstacle to the use of metallic wires for giving light by incandescence, but this was easily surmounted after the cause was ascertained. I coated the wire forming the spiral with the oxide of magnesium by dusting upon it finely powdered acetate of magnesium. While incandescent the salt was decomposed by the heat, and there remained a strongly adherent coating of the oxide. This spiral so coated was covered with a glass shade and brought to incandescence for several minutes; but instead of a deposit of platinum upon the glass there was a deposit of the oxide of magnesia. From this and other experiments I became convinced that this effect was due to the washing action of the air upon the spiral; that the loss of weight in and the colouration of the hydrogen flame was also due to the wearing away of the surface of the platina by the attrition produced by the impact of the stream of gases upon the highly incandescent surface, and not to volatilisation, as commonly understood.

"I will now describe other and far more important phenomena observed in my experiments.

"If a short length of platinum wire, one-thousandth of an inch in diameter, be held in the flame of a Bunsen burner, at some part it will fuse and a piece of the wire will be bent at an angle by the action of the globule of melted platinum; in some cases there are several globules formed simultaneously, and the wire assumes a zigzag shape.

"With a wire four-thousandths of an inch in diameter this effect does not take place, as the temperature cannot be raised to equal that of the smaller wire owing to the increased radiating surface and mass. After heating, if the wire be examined under a microscope, that part of the surface which has been incandescent will be found covered with innumerable cracks. If the wire be placed between clamping posts, and heated to incandescence for twenty minutes by the passage of an electric current, the cracks will be so enlarged as to be seen with the naked eye, the wire under the microscope presents a shrunken appearance, and is full of deep cracks. If the current is continued for several hours these effects will so increase that the wire will fall to pieces.

"This disintegration has been noticed in platina long subjected to the action of a flame, by Prof. John W. Draper. The failure of the process of lighting invented by the French chemist, Tessié-du-Motay, who raised sheets of platinum to incandescence by introducing them into a hydrogen flame, was due to the rapid disintegration of the metal. I have ascertained the cause of this phenomenon, and have succeeded in eliminating that which produces it, and in doing so have produced a metal in a state hitherto unknown, and which is absolutely stable at a temperature where nearly all substances melt or are consumed, a metal which, although originally soft and pliable, becomes as homogeneous as glass and as rigid as steel. When wound in the form of a spiral it is as springy and elastic when at the most dazzling incandescence as when cold, and cannot be annealed by any process now commonly known.

"For the cause of this shrinking and cracking of the wire is due entirely to the expansion of the air in the mechanical and physical pores of the platinum, and the contraction upon the escape of the air. Platinum as sold in commerce may be compared to sandstone in which the whole is made of a great number of particles with many air spaces. The sandstone upon melting becomes homogeneous and no air spaces exist. With platinum or any metal the air spaces may be eliminated and the metal made homogeneous by a very simple process. This process I will now describe. I had made a large number of platinum spirals, all of the same size and from the same quality of wire; each spiral presented to the air a radiating surface of three and one-sixteenth of an inch; five of these were brought by the electric current up to the melting point, the light was measured by a photometer, and the average light was equal to four standard candles for each spiral just at the melting point. One of the same kind of spirals was placed in the receiver of an air pump and the air exhausted to two millimetres; a weak current was then passed through the wire to warm it slightly for the purpose of assisting the passage of the air from the pores of the metal into the vacuum. The temperature of the wire was gradually augmented at intervals of ten minutes until it became red. The object of slowly increasing the temperature was to allow the air to pass out gradually and not explosively. Afterward the current was increased at

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intervals of fifteen minutes. Before each increase in the current the wire was allowed to cool, and the contraction and expansion at these high temperatures caused the wire to weld together at the points previously containing air. In one hour and forty minutes this spiral had reached such a temperature without melting that it was giving a light of twenty-five standard candles, whereas it would undoubtedly have melted before it gave a light of five candles had it not been put through the above process. Several more spirals were afterward tried, with the same result. One spiral which had been brought to these high temperatures more slowly gave a light equal to thirty standard candles. In the open air this spiral gave nearly the same light, although it required more current to keep it at the same temperature.

"Upon examination of these spirals, which had passed through the vacuum process, by the aid of a microscope, no cracks were visible; the wire had become as white as silver, and had a polish which could not be given it by any other means. The wire had a smaller diameter than before treatment, and it was exceedingly difficult to melt in the oxyhydrogen flame, as compared with untreated platinum; it was found that it was as hard as the steel wire used in pianos, and that it could not be annealed at any temperature.

"My experiments with many metals treated by this process have proved to my satisfaction, and I have no hesitation in stating, that what is known as annealing of metals to make them soft and pliable is nothing more than the cracking of the metal. In every case where a hard drawn wire had been annealed a powerful microscope revealed myriads of cracks in the metal.

"Since the experiments of which I have just spoken, I have, by the aid of Sprengel mercury pumps, produced higher exhaustions, and have, by consuming five hours in excluding the air from the wire and intermitting the current a great number of times, succeeded in obtaining a light of eight standard candles from a spiral of wire with a total radiating surface of 1-32 of an inch, or a surface about equal to a grain of buckwheat.

"With spirals of this small size which have not passed through the process the average amount of light given out before melting is less than one standard candle. Thus I am enabled by the increased capacity of platinum to withstand high temperatures, to employ small radiating surfaces, and thus reduce the energy required for candle-light. I can now obtain eight separate jets, each giving out an absolutely steady light, and each equal to sixteen standard candles, or a total of one hundred and twenty-eight candles, by the expenditure of thirty thousand foot pounds of energy, or less than one horse-power.

"As a matter of curiosity I have made spirals of other metals, and excluded the air from them in the manner stated. Common iron wire may be made to give a light greater than platinum not heated. The iron becomes as hard as steel and just as elastic. Nickel is far more refractory than iron. Steel wire used in pianos becomes decarbonised, but remains hard and assumes the colour of silver. Aluminium melts only at a white heat."

A LIQUID RHEOSTAT.

By F. J. SMITH.

WHILE experimenting on resistance to the electric current I have devised an instrument in which fluid is used to conduct the current under examination. This may perhaps be of use to some who are working in the same direction. The sketch (fig. 1) shows the nature of the instrument.

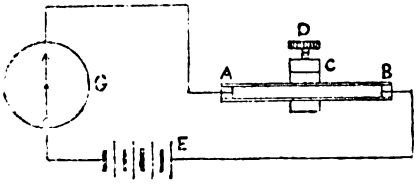

FIG. 1.

A B is a piece of elastic tube containing a weak solution of salt in water, this is held in the clamp, C. By the screw, D, the tube can be compressed and its sectional area altered, and through this its resistance. G is the galvanometer and E the battery. Finding the instrument to be very sensitive on a reflecting galvanometer, I thought that probably the tube would be a means of transmitting articulate speech. I find this to be the case. In fig. 2, A B is

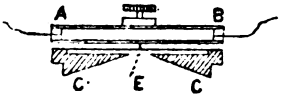

FIG. 2.

an elastic tube similar to the one used in the former instrument. C C mouth-piece, with disc connected to the tube at E. A B is put in circuit with a telephone and battery. D, screw to regulate the pressure on the tube.

Correspondence.

DUPLEX TELEGRAPHY.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—I have read with much interest the discussion in your paper on the possibility of working Duplex without the employment of condensers.

It should, certainly, be possible to re-produce by mechanical means a signal which should exactly counteract and neutralise the effect of the sending current in the relay, or other instrument employed for the reception of signals.

The rate of magnetisation of similar electro-magnets in circuits of equal resistance, is much modified by a slight inequality in the electro-static capacities of the two conductors.

That of an artificial resistance of fine wire would be very small compared with almost any line of telegraph, and the latter would, in consequence, reduce the potential of the battery in a greater ratio than the other at the instant of making battery contact, therefore, a compensating condenser is usually applied to the artificial line.

To produce the required effect without condensers, I devised the following arrangement, and although the Messrs. Theiler, in their letter, do not mention the suggestion of any plan prior to their own, they were acquainted with the above, which I explained to them

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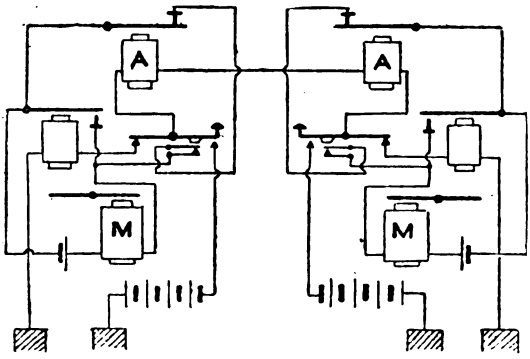
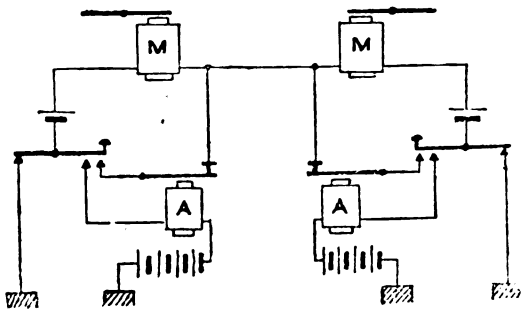
when endeavouring to borrow two Morse keys, with suitable contacts, to make a trial. They were, however, unable to lend me such a key, and I requested Mr. Ash, of the Eastern Telegraph Company, who was about that time making some experiments with the quadruplex system of his invention, to try it for me; but have not heard the result.



M, M, Morse recorders. All the relays are of soft iron, If both currents combine, then relays A, A, must have their contacts below instead of above.

It might, also, be possible to neutralise the effect of the sending current on the apparatus by a spring on the sending key itself, which could be adjusted to balance the magnetic effect of the current, and thus leave the apparatus free to respond to any alteration due to received signals.

Attached is also a method of working directly through ink writers in the line circuit.



M, M, Morse recorders. Relays A, A, are adjusted so as not to respond to the sending current until reinforced by the received current.

Yours truly,
F. HIGGINS.

The Exchange Telegraph Company,
Limited, London, E.C.

DEAR SIR,—In his letter, which you publish in your last issue, Mr. Rapieff points out the danger of patenting too much at one time. In his voluminous 1877 patent of 42 pages, 13 sheets with 112 illustrations, and 24 claims, he appears to patent all things electric, magnetic, and otherwise, and amongst them the Gramme Ring and the Siemens-Alteneck Cylinder Helix, which brightly shone in competition at the Vienna Exhibition in the year of our Lord 1873.

I fail to find from out of the labyrinth of sketches, even on sheet 6, anything coinciding with the Siemens-Alteneck Alternating Current Machine as described in your issue of 1st inst.

I am, dear sir,
Yours faithfully,
G. RISCH.

Lansdowne Road, Old Charlton,
Sept. 24th, 1879.

Notes.

ANDRÉ'S ELECTRIC MINING LAMP.—A few days since the Duke of Sutherland, Professor Keates, Chemist to the Metropolitan Board of Works, Mr. Easton, C.E., and a number of gentlemen attended at the offices of the British Electric Light Company in Parliament-street, to witness George E. André's electric mining lamp in operation. Mr. André gave an explanation of the lamp and its working, and showed its adaptability to the lighting of fiery collieries and mines generally. The atmosphere being securely excluded from the light, the risk of explosion, with its fearfully disastrous effects, is entirely avoided, and this is attained advantageously and economically, for the light emitted is of great power, and the cost far less than that of safety lamps or candles. The Duke, on taking leave of Mr. André, expressed his satisfaction at the success attained, and remarked that the lamp had a great future before it. The lamp exhibited will burn six hundred hours in a mine without being touched, four carbons being thrown into light automatically one after another.

THE ELECTRIC LIGHT AND GEMS.—Mr. Frank Flower, diamond merchant, Piccadilly, has published a small pamphlet on "Electricity as an Agent in the Household," in which he states that he has completed a standard electric clock which goes correctly by means of three cells. He also employs the electric light to illuminate his shop window, as he finds that it in no way alters the colour of gems. A diamond that is decidedly "off colour" will under ordinary gas-light pass as a white stone, and, in fact, is often more brilliant than one purely white; but not so under the electric light, by which the most ignorant could detect the light straw shade which is, for example, so familiar to us in the Cape diamonds. This advantage of the electric light will therefore be felt both by the public and the diamond merchant, who will be able to do business after nightfall.

JABLOCHKOFF'S electric light is about to be introduced into Teheran.

RESISTANCE OF THE ELECTRIC ARC.—Professors Houston and Thompson have arrived at the conclusion that within certain conditions the relation between current strength and arc resistance may be defined as follows:—1. In arcs of equal lengths the resistances are inversely proportional to the current strengths. 2. The illuminating power of an arc is approximately proportional to the current traversing it. 3. In arcs of equal lengths the total energy given out is proportional to the current strength. Details of the investigation are given in the August number of the *Journal of the Franklin Institute.*

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RANGE OF THE ELECTRIC BEAM.—On the evening of July 12, the Maxim electric light was put in operation on the tower of the Grand Union Hotel, Saratoga Springs, New York, with a view to test the extent of its illuminating powers. An open parabolic reflector was used—no lenses—and care was taken by Mr. Maxim to set the points of the carbons a little at one side of each other, and to adjust them to the exact focus of the reflector. When this was fairly accomplished, the light was turned toward a spot in Ballston Spa, New York, 7½ miles distant, where, by previous arrangement, a group of several hundred persons were assembled to witness the experiment. So powerful was the light, so accurate the focusing and alignment, that the designated place in Ballston was instantly illuminated, so that ordinary print could be read, the time seen on watches, etc. The night was clear, still, and dark. The experiment was made at half-past nine o'clock p.m. This is believed to be the greatest distance at which illumination of equal degree has been accomplished

WE hear that the representatives in Paris of the Werdermann system of electric lighting have succeeded in producing from an A Gramme machine, driven by a five horse-power gas engine, ten lights in circuit of 225 candle-power each. The machine being arranged for *intensity* instead of quantity.

ELECTROMOTIVE FORCE OF THE VOLTAIC ARC.—M. Latschinoff, of St. Petersburg, from a number of experiments has been led to conclude, with Herr Edlund, that an electromotive force of polarisation is produced in the voltaic arc. With a battery of 40 Bunsen elements, giving a current of 95 electromagnetic units, that polarisation is nearly equal to 12 Bunsen elements. The introduction of a little sodium or potassium in the arc, produces almost 50 per cent. diminution of the polarisation, and increases the length of the arc.

REYNIER'S NEW LAMP.—M. Reynier, the ingenious young French electrician who brought out the first incandescent carbon lamp, has added another improvement to the older forms. This consists in limiting the incandescent portion of the smaller electrode which impinges upon the thicker one to a certain fixed length. He does this by the use of a third lateral electrode touching the smaller one at the point which is meant to band the heated length. The current enters the smaller electrode by the lateral one, and passes on through the incandescent point of the former to the thick electrode.

PREACHING BY TELEPHONE.—Another remarkable success has just been achieved by means of the patent microphone of Mr. Louis J. Crossley, of Halifax. On Sunday, September 14, the divine service held in the Square Congregational Chapel, Halifax, was transmitted to Bradford, Saltaire, and Milner Field, a distance of 17 miles. The transmitting microphone was placed on the pulpit at a distance of three feet from the preacher, the Rev. Dr. Mellor, and there were five listening stations in circuit comprising twelve telephones. Notwithstanding the fact that the wire between Bradford and Saltaire ran beside other lines busily working, the service in the chapel was heard with great clearness; and the *Te Deum* produced a fine effect on the distant hearers. We do not know what the text happened to be, but no more appropriate one could have been found in the whole Bible than this, "His word is nigh unto thee, His word runneth swiftly."

THE TELEPHONE SYREN.—The air syren of Cagmard de la Tour, which is familiar to all who have studied acoustic science, has been imitated in Germany by means of a speaking telephone circuit. A circular disc having small bar magnets arranged on its face radially, or from centre to circumference, is rapidly rotated in front of a telephone, having the diaphragm withdrawn. This dismantled telephone is in circuit with a complete one for hearing in. When the same poles of the magnets, N., are all directed outwards, a certain note can be heard in the latter telephone; if the poles alternate N.S., the lower octave is heard. When the succession of poles at the edge of the disc is, say N.N.S., there are heard three tones; one corresponding to the interval N.N., one an octave lower, corresponding to N.S.N., and a third combination tone of three tunes, the tune of vibration of the highest, corresponding to the return, each time, of the first N. The vibration numbers are thus as 3, 2, 1. In this way, by arranging the magnets on the disc, a diversity of tones can be obtained.

ELECTRICITY AND BEE-REARING.—A correspondent of the *Deutsche Presse* describes a method, which he has adopted with success, of overcoming the obstacles frequently presented to the rearer of bees by the self-will of those interesting and profitable insects. This is no other than giving them an electric shock. Every one interested in bees knows the difficulties and dangers involved in hiving a swarm. One is often seen on a hot day in June in the top branches of a tree not to be climbed, and another in some inaccessible place seems to be preparing to set out on its wanderings. If the beemaster venture to approach, all his dexterity and experience will often not prevent him from being seriously stung. There are, indeed, several cases on record of death supervening from the stings inflicted on such occasions. Herr Freiwirth, the correspondent referred to, hit upon the idea of employing the electric force to stupefy the bees. Trials on large and small clusters, and even on single insects, answered perfectly: the bees coming in contact with the conducting wires fell stunned and motionless to the ground. They were then sorted and marked, according to the strength of the current applied. The time required for their recovery, varying from ten minutes to eight hours, was proportionate to the strength of the shock, but all came out of their trance safe and sound. Encouraged by the result of this experiment, Herr Freiwirth resolved to try it on a larger scale, namely, on bees in the hive. To this end, he introduced the ends of two conducting wires into a fully occupied honeycomb, and turned on the current for a moment; the bees soon lay on the ground, and it was half an hour before they resumed activity. Herr Freiwirth then constructed an apparatus in a small box, six inches each way, which, similar to a cartridge pouch, he wore with a strap round his body. The two wires of the apparatus were, when required to be used, fastened to rods of a suitable length, the wires of course always projecting over the ends of the rods. These ends were then applied to the swarm, a knob similar to that employed for a room-telegraph being attached to the apparatus, that the current might be turned on at the proper time.

'RAILWAY PASSENGERS will hail with satisfaction an invention calculated to add greatly to their convenience and comfort (which has just been provisionally patented by Mr. F. M. Rogers, engineer, of 29, Moorgate Station Buildings, London), by which they may know with certainty the station the train is about to enter. The means by which this is accomplished is very simple. In each compartment there is a dial resembling the

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face of a clock, upon which is painted the names of the stations on the route. A hand or pointer connected with an electrical arrangement being caused to move round the dial when a current passes through the instrument, which current is automatically sent in this way:—Upon the other side of the step-board of the first carriage composing the train is pivoted a small arm connected with a battery or other source of electricity, and as the train enters the station this arm strikes against a peg inserted under the edge of the platform. The arm is thus pressed back, and a current is sent through the wire and indicators causing the pointers to show the station reached. The arrangement described is admirably adapted for the metropolitan lines, where the carriages are permanently coupled, and constantly travel the same road. Where carriages are separated, and for long journeys, a modification is necessary. As the proposed system is simple in action, and inexpensive in application, there is no reason why it should not soon come into extensive use. The name of the station being shown in the compartment of the railway carriage, it is to be hoped that ere long the indistinct calling of porters, and the confusion and uncertainty frequently witnessed at stations, may become things of the past.

ST. ELMO'S FIRE appears to have been unusually frequent in the Alps of late. In our last issue we chronicled the illumination of an entire pine forest by the silent discharge; and more recent reports announce another display on the Gross Glockner Mountain, where some Alpine tourists were willy-nilly forced to play a part as fiery demons in the "Walpurgis-nacht." Nature, says one of these impressed imps, was lit up as if by a vast conflagration; we were clad as in a garment of lightning, and the thunder rolled with deafening din, and was repeated in stunning echoes from every crag, while the gale sent piercing whistles from the narrow fissures. All six were temporarily blinded by the glare of electricity, and when they recovered the use of their eyes, to their astonishment,

> Sudden, breaking in their raptured sight,
> Appeared the splendour of St. Elmo's light.

Hair and beards, hats and coats, emitted electric sparks, and from the very cords attaching their head coverings to their lappels, and from the tops of their alpenstocks streamed the electric fluid. This play of flitting phosphorescence and golden corruscation on the lone background of eternal snows was very picturesque.

THE new American Union Telegraph Company has been interdicted from running wires on government poles through Philadelphia, at the instance of the Western Union Company, on plea that the American Union was violating a city ordinance. The American Union had, however, first obtained the consent of the secretary of the navy. The fact that two poles of the American Union line have been cut down is also causing some scandal in America like that which was raised concerning the breaks in the Direct United States Cable, before it was taken over by the Anglo-American Company. The American Union Company is expected to open for business on October 1, with offices in all the chief cities east of Chicago.

ELECTRIC UNITS.—Professor Everett's handy little volume on "Units and Physical Constants" (Macmillan and Co.), has just entered a second edition, which contains additional explanations on points of theory, and other improvements. The book has already made good its title to the use of all students of science, and the electrician will find in it his own new-fangled and puzzling units admirably expressed.

THE CAPE CABLE.—The s.s. *Seine* reached Aden on September 17th, on her return from having completed the Mozambique and Delgoa Bay section of the Cape Cable, thus completing the line of telegraphic communication from Natal to Mozambique. It is believed that the other section, from Mozambique to Zanzibar, would be finished by September 20th. When this has been done, a voyage of nine days will still be necessary to convey messages from Zanzibar to Aden. It is worthy of note that the news from Natal to England which handselled the cable just laid was the announcement of Ketchwayo's capture.

FOREIGN ITEMS.—The German underground telegraphs, connecting all the forts with Berlin, will be completed next year. A telegraph party in the Shaturgardan Pass, Afghanistan, has been attacked by Ghilzais, and 20 workmen killed. The Russian field telegraphs in Central Asia have been repeatedly cut by Turcomans. The Cuban rebels have interrupted the telegraphic communication between Holquin and Santiago.

THE TRANSFORMATION OF SOUND INTO LIGHT.—We drew attention in a recent note to the re-invention of the phoneidoscope of Mr. Henry Edmunds, by a French *savant*, M. Raimond Coulon, Conservator of the Industrial Museum at Rouen, and have since received the assurance of that gentleman that he had no knowledge whatever that any one had been working on the same subject with like results. The phoneidoscope was first exhibited at Mr. Preece's lecture on the telephone last winter at the Royal Institution.

THE British Association have granted £20 to Prof. W. E. Ayrton for the furtherance of his researches on the Specific Inductive Capacity of the Sprengel Vacuum. The same amount has been allotted to Professor W. G. Adams, for a standard of white light. Sir William Thomson also received a similar sum for experiments on the elasticity of wires.

A CONVENTION concluded between the Governments of England and France fixes the rate of charge for telegraphic messages between the two countries at 20c. per word. Negotiations have also been commenced with Spain, Italy, Switzerland, and Belgium for the establishment of a fixed telegraphic tariff.

ELECTRO-OPTISM OF LIQUIDS.—The principal results of Dr. J. Kerr's electro-optic experiments on liquids are stated by him as follows:—When an insulating liquid is traversed by electrostatic force, it exerts a purely birefringent action upon transmitted light. In relation to this action, liquids are devisible into two classes, the positive and the negative. Positive liquids act as glass extended in a direction parallel to the lines of electric force, or as plates of quartz or other positive uniaxals, with axes parallel to the lines of force. Carbon disulphide is the best example. Negative liquids act as glass compressed in a direction parallel to the lines of force, or as plates of Iceland spar or other negative uniaxals, with axes parallel to the lines of force. Colza oil is one of the best examples. All the negative liquids yet known belong to the class of the fixed oils. Sperm oil holds an exceptional place, being clearly positive. The influence of density on electro-optic power is marked and certain in the case of paraffin oils, increase of density being accompanied by increase of electro-optic power.

ELECTRIC DISTILLATION.—The further researches of M. Gernez on the evaporation of water under the in-

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fluence of electrification have led him to the conclusion that the water creeps up the walls of the tube in which it is confined, from the positive pole towards the negative. If paraffin be painted on the walls so as to stop this passage of the liquid, the transference of the latter is stopped. There may be a slight formation of vapour under the action of the electrification, but it is very slight indeed, for the vapour collects in the bend of the inverted U tube, and very little reaches the negative pole to condense there. If the liquid experimented upon be a very bad conductor, such as the chloride and sulphate of carbon, chloriform, and essence of turpentine, the distillation does not take place; but, generally speaking, when the discharge passes, the transport is greater the less the conductivity of the liquid. Thus, if alcohol be added to distilled water, lessening its conductivity, the transport is increased; and, on the other hand, if sulphuric acid be added to water, so as to improve its conductivity, the transport is reduced. A homogeneous mixture of two liquids under the electric action results in their partial separation, for they are found to distil over in proportions which are neither in ratio with the volatility nor the conductivity of the liquids. For example, in operating with a mixture of alcohol and water, a liquor less rich in alcohol is obtained.

ELECTRO-DYNAMIC INDUCTION.—MM. Borgman and Ziloff, starting from the formula of Clerk Maxwell, have arrived at the conclusion that a dielectric medium does not influence electro-dynamic induction, but, on the other hand, a magnetic medium increases the electromotive force of induction in the ratio of 1 to $1 + 4\pi k$, where k represents the magnetising function of the medium. M. Borgman also finds that the medium influences the duration of the induced current.

THE thermo-electromotive force set up at the contact of a conductor with a wire carrying a current has been made the subject of a recent investigation by M. Borgman, of St. Petersburg. It is known that a change of structure takes place in a conductor by the passage of a current through it, and M. Borgman finds this change capable of producing a thermo-electric force. After reducing to zero the current in a Wheatstone bridge, formed of iron wire traversed by a powerful current, the author heated one of the contact points and occasioned a deflection of the needle. Reversing the battery changed the direction and amount of the deflection, thus proving the existence of an electromotive force in the bridge itself.

THE RATAPHONE is the name given by Prof. Dolbear to a new telephone of his invention, which is a kind of cross between the Bell receiver and the motograph of Edison. It consists of a short straight bar electromagnet furnished with a crank, so that it may be rotated within its coil. Lying on the poles are the ends of a bent armature (of horse-shoe form), the back of which is fastened to a plate of mica, or paper, or thin iron, mounted as in ordinary receivers, so that any motion of the armature poles will be imparted to the plate. When a current traverses the bobbin, the straight bar becomes a magnet, with strength proportionate to the strength of the current, and the armature adheres to the poles of it with a certain strength of adhesion. Now let the crank be turned slowly, and the adhesion of the armature will result in stretching the plate, and the cessation of the current will let the plate regain its former position through its elasticity. A varying current will result in varying adhesions and consequent vibrations of the plate, and talking may be plainly heard with an instrument constructed thus.

New Patents—1879.

3565. "Dynamo-electric machines." W. ELINOR. Sept. 4.

3577. "Signals for telephone and telegraph lines." W. T. WHITEMAN (communicated by S. W. Francis). Complete. Sept. 5.

3645. "Electric telegraphs." W.C. BARNEY. Sept. 11.

3653. "A new or improved toy, wherein figures are moved by means of magnets." G. W. VON NAUROCKI (communicated by N. Kamprath). Sept. 13.

3659. "Improvements in means employed for electrical firing, and in fuses for the same." S. J. MACKIE. Sept. 13.

3679. "Insulators for telegraph wires." G. F. REDFERN (communicated by J. H. Bloomfield). Sept. 13.

3777. "Improvements in or applicable to electric and other puncturing pens employed for manifold writing." T. COAD. Sept. 19.

3778. "Improvements in the manufacture of metal rods or wire with a vitreous coating chiefly designed for telegraphic cables, and in devices for aligning and coupling such cables." W. R. LAKE (communicated by P. Arbogast and T. J. McTighe). Complete. Sept. 19.

3794. "Improvement in apparatus employed in connection with telephones, for the purpose of notifying and of facilitating and obtaining interchangeable communication between telephonic circuits." A. WHITE (communicated by T. A. Edison). Sept. 20.

3831. "Protecting and insulating underground telegraph wires." P. JENSEN (communicated by W. E. Prall and H. Olrick). Sept. 23.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

382. "Electric lamps." JOHN IMRAY. Dated Jan. 30. 2d. This consists in making electrodes out of hollow carbon tubes, which rotate round their axis at the same time that they are made to approach each other, so as to cause the consumption of carbon to take place in a helical direction, so that each tube furnishes a length of carbon equal to the length of the helix. *(Not proceeded with.)*

389. "Reflectors for electric lighting apparatus." W. R. LAKE. Dated January 30. 2d. To obtain a diffusion of the electric light, without waste from the use of thick globes, reflectors of silvered glass are to be employed. *(Not proceeded with.)*

390. "Protecting coating for ships, telegraph cables, &c." GEORGE WATSON. Dated January 30. 2d. To protect cables or submarine structures from oxidation or from fouling by animal or vegetable growths, "sene-grease" (obtained from coal tar, fats, &c.) is to be applied by a brush, or by soaking the sheathing of the cable. The grease is made into the consistency of paint by mixing it with naphtha, resin, &c.

394. "Telephones." F. A. GOWER and C. ROOSEVELT. Dated January 30. 6d. This describes Gower's well-known form of telephone.

412. "Compound microphones." L. J. CROSSLEY. Dated Feb. 1. 6d. This describes the quadruple-contact or four-carbon microphone, fully illustrated in the TELEGRAPHIC JOURNAL for May 1.

416. "Electric lamps." J. D. F. ANDREWS. Dated Feb. 1. 2d. The electrodes are formed of two carbon discs placed fronting each other, and the arc is formed

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between the edges. As these consume, the arc travels round, gradually paring down the carbons towards their centre. *(Not proceeded with.)*

427. "Electric lamps." C. DUBOIS. Dated Feb. 3. 4d. This describes a lamp in which the carbons are of a curved shape like those of Mr. Heinrichs, illustrated in our last number.

465. "Luminous electric buoys." S. W. M. De Sussex. Dated Feb. 5. 2d. This describes modifications on the buoy patented in No. 2,194, of 1877. The buoy is lighted by a discharge from a Ruhmkorff coil, excited by a zinc-graphite battery attached to the buoy or within it, the discharge passing through a Geissler tube containing hydrogen or carburetted hydrogen as giving the most brilliant light. The tubes are made several feet long, then rolled into a luminous centre, and they are enclosed in a lantern of crystal or, preferably, uranium glass. *(Not proceeded with.)*

477. "Galvanic batteries." T. SLATER. Dated Feb. 6. 6d. Nickel in a rod or in grains is used for the positive pole, and carbon in rods or prisms for the negative, with a porous diaphragm between, where two fluids are used. The excitant may be dilute sulphuric, nitric, or hydrochloric acid. A compound cell is also made with two concentric diaphragms which divide it into three compartments; in the centre is the nickel with its oxidiser, the dilute acid; in the middle one is a solution of sesqui-carbonate of ammonia, and in the outer is a solution of sulphate of nickel or double sulphate of nickel and ammonia together with the carbon plate.

485. "Sounders for telegraphic purposes." J. R. EDWARDS. Dated Feb. 7. 2d. Below the long pole of the ordinary sounder an electro-magnet is fixed, whose core passes through the long pole of the permanent magnet, and is magnetised by it and made in two adjustable parts. Another electro-magnet is placed below the shorter pole of the permanent magnet. The iron cores of these electro-magnets face each other with an adjustable space between. An armature carrying the striking hammer is pivoted to the short pole of the permanent magnet and magnetised by it. This armature is operated by the current passing through electro-magnets which reverses the polarity of the upper, and the armature is pulled down and strikes the bell. *(Not proceeded with.)*

508. "Shades of lanterns for electric lights." H. VAN DER WEYDE. Dated Feb. 8. 6d. To diffuse the light, annular reflectors in parallel zones are employed in two sets separated by an equatorial band or prism of glass, and they are slightly concave, the upper set on their lower and the lower on the upper surface. They are placed so as to intercept the upwardly and downwardly projected rays and throw them out horizontally.

523. "Electric light." E. J. BOUSFIELD and W. R. BOUSFIELD. Dated Feb. 10. 6d. This consists in constructing the armature of dynamo-electric machines in the form of a drum with coils surrounding H shaped cores; in a regulator or brake for adjusting the electrodes of an electric lamp consisting of an iron-rimmed wheel acted on by the pole of an electro-magnet near it through which the current passes, so as to retard the motion of the wheel when the current was strong, and thus check the approach of the carbons.

The use of a negative metal electrode, kept cold by a cold blast, for carbon, after the manner of Siemens, is also described.

595. "Generating compound induced currents for telephonic and other purposes." R. H. COURTENAY. Dated Feb. 14. 2d. This consists in uniting a magneto-electric generating apparatus to the ordinary apparatus for telephoning musical sounds. *(Void by reason of the patentee neglecting to comply with the conditions of letters patent.)*

644. "Magneto-electric or dynamo-electric machines." J. F. WILES. Dated Feb. 18. 6d. Instead of fixing either the magnets or armatures in position and causing the one or the other to revolve as heretofore, both the magnets and the armatures are mounted on separate axes of motion, so that the armatures are revolved in one direction while the magnets are revolved in the other, whereby the same relative speed of the parts as that now obtained may be produced whilst giving a slower rotary motion to the axes on which the same are mounted. By these means the machine can be driven direct from a steam engine or by other motive power without the intervention of any description of multiplying apparatus.

749. "Galvano-magneto-dynamo-electric machine." C. DUBOS. Dated Feb. 25. 6d. The electro-magnets of this machine are made in the form of double rings of soft cast-iron, having segmental collars on them, between each pair of which insulated wire is coiled transversely to the circumference of the ring over the double annular cores, each coil being so wound and so connected in the circuit of the machine, that the electrical current through its coil is in the opposite direction to that in the next coil on each side of it. Within this annular electro-magnet is a rotatory disc set with armature coils. The ring coils are first excited by a battery.

General Science.

GLASS SLEEPERS.—Rail and tramway sleepers of glass, hardened by the Siemens' process, have recently been introduced into this country, and are being tried on the Stratford tramways.

LUMINOUS FLOWERS are one of the latest novelties on the Parisian boulevards. They are made by varnishing the petals with phosphorescent sulphide of calcium or sulphide of barium, and shine with a lambent light in the dark.

ILLUMINATING GAS FROM RICE HUSKS.—A process calculated to be of great value in rice-producing countries, has been patented in this country by Mr. Muller, a young Dutchman, now resident in London. It consists in decomposing the chaff of rice in a retort by heat, and collecting the illuminating gas given off. By this means from 15,000 to 20,000 cubic feet of excellent gas can be obtained from a ton of husks. The carbonaceous residue is kneaded with tar or oil into an artificial fuel.

THE CHROMOGRAPH AND TRYPTOGRAPH are new devices for multiplying copies of manuscripts. By the Chromograph the writing while fresh is transfered to an elastic tablet, and as many as fifty copies are impressed therefrom by merely laying the paper on it and passing the hand over the back. By the Tryptograph a stencil is made by writing on a plate which pierces the paper, and copies are made from the stencil after the manner of Edison's Electric Pen or the Horograph.

FORBES'S ACOUSTICAL FIRE-DAMP DETECTOR.—This handy little instrument is intended to measure the quantity of fire-damp in a coal mine. From the rough model shown by Prof. George Forbes, of the Andersonian University, Glasgow, the committee of the British Association have constructed two new

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instruments which appear to them to answer their purpose. Both are founded on the facts that sound travels quicker in light gases than in dense ones, and that air which is contaminated with fire-damp is lighter than pure air. The velocity of sound in different qualities of air is compared by noting the lengths which must be given to a brass tube to cause it to resound to a tuning-fork. The length of tube is proportioned to the velocity of sound. The instrument consists essentially of a tube with a tuning-fork at one end of it and closed at the other end by a piston, which can be moved in and out so as to lengthen or shorten the tube. The tuning-fork is caused to sound, and on moving the piston in and out the sound is heard to augment and diminish according to the position of the piston in the tube. The piston must be left in that position which gives the loudest sound. The length of the tube under these conditions measures the velocity of sound, and thence the percentage of fire-damp in the air. In the larger form of the instrument the fork is kept in vibration by an electric current, which is made and broken at each vibration by the fork interrupting the circuit of an electro-magnet. In the smaller form the fork is put in vibration by means of a tapering rod drawn between the prongs by hand. A thermometer attached enables a small correction for temperature to be made, and the percentage of gas to within 1 per cent. is pointed out on an indicating dial.

A NEW FLUORESCENT BODY.—According to the *Journal of the Chemical Society*, C. O. Harz has discovered a new fluorescent body in *spergulin*. This product occurs in the seed-coverings of the caryophyllaceous plants, *Spergula vulgaris* and *S. maxima* (Anglice "Spurrey"). It is produced at the time when the seeds blacken and are nearly ripe. Spergulin is very soluble in absolute and aqueous alcohol. Viewed by transmitted light the solution appears nearly colourless, with a shade of olive-green; by reflected light it exhibits a dark blue fluorescence. It has not yet been obtained in the form of crystals. It is very soluble in methylic alcohol, less so in amylic alcohol, and scarcely soluble in ether or petroleum. Concentrated sulphuric acid dissolves it, forming a dark blue liquid. The fluorescence of an alcoholic solution of spergulin is maintained for more than a year if the liquid be kept in darkness, but is rapidly destroyed by the action of direct sunlight, and more slowly by that of diffused light. Small quantities of caustic alkalies, or alkaline carbonates, added to an alcoholic solution of spergulin, transform it into an emerald-green fluorescent body; and basic lead acetate produces a precipitate. The new compound contains 61·85 per cent. of carbon, 7·05 of hydrogen, and 31·8 of oxygen. It appears to be related to chlorophyl, and is probably closely allied to phyllocyanin. An alcoholic solution of the product showed strong absorption, almost entirely in the violet; and in this respect differs considerably from chlorophyl, phyllocyanin, and phylloxanthin. Mr. Harz is disposed to regard spergulin as a feeble acid, the acid salts of which, as well as the acid itself, exhibit blue fluorescence, the neutral salts exhibit green fluorescence, and the basic salts are destitute of fluorescent properties.

MALLEABLE NICKEL AND COBALT.—A German chemist, Herr Fleitmann, has succeeded in producing perfectly malleable nickel and cobalt on removing the carbonic oxide observed by them, by adding small quantities of magnesium through a hole in the lid of the crucible after the oxygen had been removed by means of charcoal.

TRANSPARENCY OF METALS.—With the aid of electricity films of several metals of such minute thickness as to allow the light to pass through them can be produced. An electric current is passed into a wire of one of the metals, that extends into a glass tube containing rarefied air or gases. The particles of metal that the electric current loosens from the wire are deposited on the sides of the tube and form a transparent film. The light that passed through gold was a very handsome green, silver produced blue, copper light green, platina bluish gray, zinc dark bluish gray, and iron brown.—*Chemiker Zeitung.*

OZOKERITE.—A large deposit of ozokerite, 20 miles long and 20 feet thick, has been discovered in Utah territory, U. S. It is harder than the ordinary ozokerite; but its insulating properties have not as yet, we believe, been tested. The production of ozokerite oil in the Eastern Galicia oil fields is very limited in amount at present. The wells are mostly situated near Boryslaw, though there is one well south of Boryslaw about 45 miles, that is doing 8 to 10 barrels per day of nice green oil. The wax fields of Eastern Galicia attract the most attention. This earth wax, or ozokerite, as it is called, is neither more nor less than oil that has been evaporated, leaving the residuum in a solid state, so that it is dug out with picks and shovels, and is about the consistency of common clay. It is very valuable, being worth from 7 to 8 cents a pound. The shafts are from 350 to 600 feet deep and very close together, so close that, on the piece of land where this wax is found at Boryslaw, containing not over 50 acres, there are 10,000 shafts. The walls of these shafts are curbed with timbers, but at the depth to which they go they are very thin, so that scarcely a day passes but the walls cave in, breaking the timbers like pipe stems, and burying several human beings beneath the great mass of earth. This thing occurs so frequently, that from four to six persons per week are killed in this manner. Great fortunes have been accumulated by a few of the Jews who owned the land where the wax was found. The vein is about 16 inches thick, and the wax is carried out in buckets. Twelve thousand men live on that 50 acres of land, how, nobody knows. The wax is refined and made into candles; and, being an excellent insulator, also into condensers for electrical purposes.

MOVING ROCKS.—It is well known that the shingle of a sea-beach slowly travels along the shore, and a remarkable instance of the fact is to be found in the great Chesil bank of a natural breakwater of shingle curving between the island of Portland and the Dorset coast near Weymouth. Here the pebbles are actually assorted by the action of the tide, so that the larger ones are met with at the east end towards Portland, while the smaller ones become more abundant as one follows the bank in a westerly direction. So regular is the grade of size that fishermen who land at night on the bank can tell roughly how far they are from Portland by handling the pebbles. Moving rocks are, however, a more remarkable and unheard-of phenomenon. That daring sportsman, Lord Dunraven, has recently given an interesting account of some which he witnessed at a lake in Nova Scotia during the autumn of last year. The lake itself was spacious but shallow, and its bed was strewn with masses of rock of various sizes, from boulders six or eight feet in diameter to stones of a few pounds' weight. Many of these blocks appeared to have travelled right out of the water, and are now high and dry several yards up the shore. In all cases there is a distinct groove or furrow marking the track which the rock has ploughed for itself. The only cause of the curious fact which Lord Dunraven can suggest is the action of ice, but how the ice acts he does not venture to explain.

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City Notes.

Old Broad Street, Sept. 27th, 1879.

DIRECT SPANISH TELEGRAPH COMPANY LIMITED.—The report of the directors for the half-year ending 30th June, 1879, to be presented at the general meeting of shareholders being held as we go to press, states that, "the accounts for the half-year ending 30th June, 1879, show a balance to the credit of profit and loss of £3,445 18s. 3d. The traffic receipts for the half-year are £545 17s. 10d. in excess of those for the corresponding half-year of 1878. This result has been attained in the absence of any improvement in business in Spain. The company's submarine cables continue to work perfectly, and remain in the same high electrical state as heretofore. The dividend on the 10 per cent. preference shares, which it is proposed to pay on 1st October, will absorb £2,921 10s. od., leaving £524 8s. 3d. Of this sum the directors recommend that £500 be added to the reserve fund, which will then amount to £2,200, after which there will remain a balance of £24 8s. 3d. to be carried forward."

DIRECT U.S. CABLE COMPANY.—By the Articles of Association of this Company, the Directors are expressly authorised to borrow £100,000, and to issue debentures for the same on such terms and conditions as they may think fit. Previously to and at the last Ordinary General Meeting of the Company, the Members were informed that, in order to complete the financial arrangements for the settlement of the interests of the dissentients from the re-construction, and for the general purposes of the Company, it was intended to exercise the debenture power given by the Articles. The Directors have now decided to make the issue in 1,000 debentures of £100 to bearer, repayable in five years from the 15th October, 1879, bearing interest at £6 per cent. per annum (payable half-yearly), and to offer the same in the first instance to the Members at par.

At a meeting of the board of the Anglo-American Telegraph Company (Limited) to-day it was resolved (after placing £37,500 to the credit of the renewal fund) to declare the following dividends, all free of income-tax and payable on Nov. 1, 1879, leaving about £7,000 to be carried forward to next quarter's account: 1. An interim dividend of 1½ per cent. upon the ordinary consolidated stock for the quarter ending Sept. 30, 1879; 2. An interim dividend of 1½ per cent. upon the deferred stock for the same quarter; and 3. A balance dividend for the year 1879 of 1½ per cent. upon the Six per Cent. Preferred Stock. No further dividend will be payable on this stock for the year 1879.

The directors of the Eastern Telegraph Company (Limited) have declared an interim dividend of 2s. 6d. per share for the quarter ended June last.

The directors of the Eastern Extension Telegraph Company (Limited) have declared an interim dividend for the quarter ended June 30 last, of 2s. 6d. per share, or at the rate of 5 per cent. per annum, free of income-tax.

The board of the Indo-European Telegraph Company have declared an interim dividend for the half-year ending June 30 last, at the rate of 5 per cent. per annum, free of income-tax.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 55¼-55⅝; Ditto, Preferred, 82½-83; Ditto, Deferred, 29-30; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 7½-7⅝; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 1⅞-2¼; Direct Spanish, 10 per cent. Preference, 11¼-11⅝; Direct United States Cable, Limited, 1877, 10¾-11; Eastern, Limited, 7⅞-8; Eastern, 6 per cent. Debentures repayable October, 1883, 104-108; Eastern 5 per cent. Debentures repayable August, 1878, 102-104; Eastern, 6 per cent. Preference, 11⅛-12⅛; Eastern Extension, Australasian and China Limited, 7⅞-8; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, par 1 pm; Ditto, registered, repayable 1900, par 2 pm; German Union Telegraph and Trust, 7½-8; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 11¼-11½; Great Northern, 8⅞-8⅞; Indo-European, Limited, 21⅛-22⅛; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9-9⅛; Reuter's, Limited, 9-10; Submarine, 224-229; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1⅛; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference 7-7⅛; Ditto, ditto, Second Preference, 6-7; Western and Brazilian, Limited, 2¾-3; Ditto, 6 per cent. Debentures "A," 95-99, Ditto, ditto, ditto, "B," 89-94; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-106; Telegraph Construction and Maintenance, Limited, 31⅛-32; Ditto, 6 per cent. Bonds, 105-107; Ditto, Second Bonus Trust Certificates, 2⅛-2⅜; India Rubber Co., 12¼-12⅝; Ditto, 6 per cent. Debenture, 102-106.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
August, 1879 ...	51,300	*9,880	2,300	978	17,100	36,257	26,242	16,800	... ...	10,789	... ...	11,113	3,884
August, 1878 ...	43,720	11,244	2,569	879	14,570	35,889	24,870	18,413	... ...	10,151	... ...	... ...	4,417
Increase	7,580	*	... ...	99	2,530	368	1,372	... ...	... ...	638	... ...	... ...	... ...
Decrease	... ...	... ...	269	... ...	... ...	... ...	... ...	1,613	... ...	... ...	... ...	... ...	533

* Four weeks only, against 31 days of last year.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 161.

THE ELECTRIC LIGHT.

AFTER a period of quiescence extending throughout the summer and the long evenings, there are now unmistakeable signs that the electric light has resumed some of its old activity, and that there is still a demand for it, which can be to a certain extent supplied.

At this time last year the fever of public excitement raised by the rash announcement of Mr. Edison, was just at its height. There was a perfect scare amongst the holders of gas shares; and the whole electrical world was on tiptoe of eager expectation to learn what the wonderful inventor of the phonograph, the man whose daring ingenuity seemed to have something terrible and irresistable in it, had achieved in solving the problem of general illumination by means of the electric current. Elderly men who had lived through such panics before and seen similar enthusiasms die down, preserved their equanimity, and ventured to predict that Edison's reputed success would prove a chimera; while younger men, who had not before experienced any of the periodic storms of false alarm which disturb existing industries, and who were ready to pin their faith to a young inventor who had won their admiration, were, as it turns out, over sanguine of the declared result.

A year has passed since then, and the Edison light which was to be blazing in our drawing-rooms, and glowing in our closets by this time, has not made its appearance. The mountainous preparations which were made at Menlo Park have given birth to nothing bigger as yet than a mouse. Small lamps have been seen there it is true, but the public illumination of the town has not come off; and there are some evil reports from New York to the effect that Edison has given up the attempt and retired from the field, under cover of a despairing cry for "more platinum."

We do not credit the bitter aspersions of the American press, any more than we put faith in the extravagant praises which the same organs heaped on the inventor's head in the heyday of his fame. Too many American journals govern their expressions by the licence of sensation rather than by the canons of good taste, or the pure limits of truth, and those who laud a man to the utmost excess at one moment are the very first to cover him with opprobrium the next. It appears to us that Mr. Edison is by no means hopelessly defeated in his endeavour to publicise the electric light. He has been resolutely at work of late instead of haranguing reporters in a battered hat, and making boasting speeches, which some of these same gentlemen are turning against him now; and the remarkable paper which he recently read before the American Scientific Association on the heating of metals in vacuo, proves that he is not the man to be deterred by obstacles which have overthrown the efforts of al other inventors who have tried to make electric lighting by incandescent wires a practical success. "I can," he says, "now obtain eight separate jets, each giving out an absolutely steady light, and each equal to 16 standard candles, or a total of 128 candles, by the expenditure of 30,000 foot-pounds of energy, or less than 1 horse-power." This is a good long way behind what he promised us, but it does not look like a hopeless failure.

One substantial result of Edison's efforts in electric lighting has been their stimulating influence on other electricians. During the past year patents for electric lighting have literally flowed into the British and Foreign Patent Offices, and many excellent electric lamps have been perfected and exhibited. The public too have been aroused to the advantages of the system, and it can truly be said that the electric light never had a better opportunity than it has now, and indeed that it never before took a better advantage of it. For, although street illumination is only in vogue in one or two places, such as the Avenue de l'Opéra, Paris, the Thames Embankment, and the waterside promenades of Blackpool; hall, ship, and factory lighting is proceeding apace. At Blackpool it has proved a capital speculation, for although the installation will cost the town authorities at least £2,500, the place has been literally thronged with visitors. Street illumination, though tardy in its progress, is not at a standstill, and it has a very good chance of adoption in colonial and oriental cities, like those of Algeria, Persia, and Brazil, where it will not have to encounter the vested interests of gas-light already in use.

The winter exhibitions of rival electric lights have begun again in London; an interesting one, detailed on another page, of the Lontin system having taken place at the Aldersgate Street Station, of the Metropolitan Railway. Eight Serrin-Lontin lamps were suspended over the platforms. The motive power was furnished by a high pressure compound engine of 25 horse-power nominal, capable of working up to 60 horse-power. The machinery consisted of an exciter and a distributor, the latter

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making 410 revolutions per minute and the former just half that number. The eight lights were maintained on four circuits, and the engine was stated to be working up to about 14 horse-power. In fact, it is claimed for the Lontin machine that it will maintain a lamp equal in lighting power to 600 candles by the expenditure of from one to one and a quarter horse-power, the economy of power increasing with the number of the lamps. The carbons are stated to burn at the rate of three inches per hour, and the entire cost of coal and carbons is reckoned at less than threepence per hour for each lamp. This result is considerably cheaper than gas-lighting. The improved Lontin machine is claimed to possess the advantages of working at low speed and admitting of the ready sub-division of the light. As many as twelve lights have been placed in one circuit on this system.

Another advance has been the extension of Jablochkoff's system to Waterloo Bridge.

Other projected applications of the electric light can be cited. For instance, the authorities of the British Museum have decided to light the reading-room during this winter by Siemens' lamps, hung near the roof and provided with reflectors to throw the rays down on the floor below. By this means it will be possible to keep the library open for several hours after dark without danger of fire. From Paris we learn that the *foyer* of the new Opera house is to be lit by four Jablochkoff candles and four of Werdermann's type, and the experiment will be a kind of competitive trial between these two plans, to determine which of them is the more suitable for the subsequent lighting of the whole house.

The most interesting news on this subject is, however, the statement made by Mr. Harding at the exhibition of the Lontin light, above-mentioned, to the effect that Mr. Crookes is engaged in some experiments with the electric light in vacuo, which promise to work an entire revolution in the prospects of the light. Carbons would be dispensed with, and the lamp would consist in a luminous globe giving a light of say three candles. Thirty of these lamps would, it was thought, be maintained by an expenditure of 1¼ horse-power, at a cost of less than a penny per hour. We have always believed that there was something to be made by some one in the way of electric lighting out of Mr. Crookes' researches in vacuo, and we are gratified to hear that that eminent physicist is so near success himself. Mr. Edison and he are trenching upon the same ground with vacuo; but, whereas the former uses metal electropyres the latter uses none. Both are on the proper tack it seems to us, namely, the production of a perfectly steady light without any wasting of carbons or other perishable parts. As yet, however, Mr. Edison's method would seem to be the more economical of the two.

The facts which we have referred to in the course of this article, if they do not show any very remarkable advance in the means of illumination by electricity, are at least amply sufficient to demonstrate that difficulties are steadily being overcome as they are met, and, as we have maintained on former occasions, that the electric light is now established for good, to be slowly improved and extended by degrees like any other capable invention.

HADDEN'S DIPLEX TELEGRAPH SYSTEM.

THIS system, the invention of Mr. W. Hadden of the American Union Telegraph Company, is for the purpose of enabling two messages to be sent in the *same* direction on one wire at the same time. The principle of the invention is shown by the figure.

At the transmitting end of the line, K^1 and K^2, are the two working keys, 1 is an "interrupting" wheel which is kept rotating at a high velocity by means of mechanism, and is provided with projecting teeth which cause contact to be alternately made and broken with great rapidity between the two springs which are respectively connected to earth and to the key K^1.

E^1 and E^2 are two batteries, the latter of which is three times as powerful as the former.

The action of these keys, interrupter, and batteries, is as follows:—

When both keys are at rest the "interrupter" and battery E^2 are short circuited, whilst E^1 sends its uninterrupted current of "one" out to line. When key K^2 is depressed alone both batteries are in circuit, and a current equal to "four" goes out to line.

When key K^1 is depressed alone then both E^1 and E^2 will he short circuited, and consequently "no" current will flow out to line.

Lastly, when both keys are depressed it is evident that both batteries will be in circuit with the "interrupter," and consequently an interrupted current of "four" will flow out to line.

To see how these various currents cause the apparatus at the receiving end of the line to respond, let us examine the action of the relays R^1 and R^2.

When both keys are at rest, then relay R^2 is held against its contact point by the bias of its pole against the uninterrupted current of "one" on line. Relay R^1 is held against its contact point by the same current on line against the bias of its pole.

When key 1 is depressed and puts the full current of "four" on line, then this current overcomes the bias of the pole in relay R^2, thereby throwing over the tongue; but it does not move the tongue of relay R^1, as it is already held over by a lighter current of same polarity.

When key K^2 is depressed and cuts off all current from the line by short circuiting the battery already on the line, this permits tongue of relay R^2 to be thrown over in obedience to the bias of the pole.

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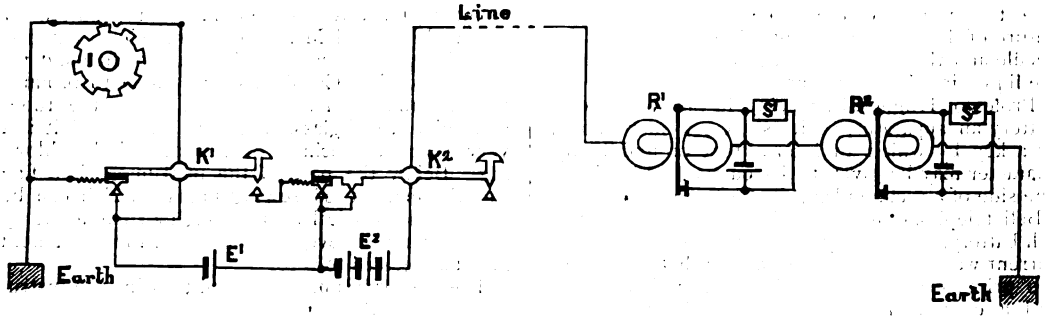
Lastly, when both keys are depressed and the current from the whole battery passes through the mechanical interrupter, which is in motion, the effect of the interrupted current is to set the tongues of both armatures in vibration, so that in the case of relay R^2 as the tongue is held against the contact point by the bias of the pole, when the impulses from the whole battery come, it moves in obedience to them, and in the case of relay R^1 as the tongue is held against the contact point by the influence of a current on the line, when the intervals of no current come, it vibrates in obedience to the bias of the pole.

The local circuits are so arranged that the sounders s^1, s^2, are short circuited when the relay tongue contacts are together. When the tongues are thrown over by the action of either key, or put in rapid vibration by the simultaneous action of both keys, the circuit is wholly through the sounders. There are several ways in which the local circuits may be arranged, which are practically superior to the manner shown, which is only intended to be theoretically perfect.

If the movement of the keys and the resultant effects are carefully followed it will be seen that no circuit-preserving attachments are necessary,—the only change from the common key being the extra contact points.



ON A GALVANOMETER FOR DEMONSTRATING THE INTERNAL CURRENT TRANSMITTED THROUGH THE LIQUID WITHIN A VOLTAIC CELL.

Paper read before Section A of the British Association at Sheffield, August 25th, 1879.

By CONRAD W. COOKE, C.E., M. INST. T.E.

IT is, of course, well known that when the external circuit of a voltaic cell is closed a current of electricity is transmitted through that circuit, and at the same time a current of equal strength is transmitted through the liquid within the cell from one plate to the other. These two are in reality but portions of the same current, and are for convenience known as the external or internal currents respectively, to distinguish that portion of the main current which flows through the external conductor from that portion which is transmitted from plate to plate within the cell. The former of these is detected by its electro-magnetic and electro-chemical effects, producing deflections in galvanometers and electroscopes and sounds in telephonic instruments, and is utilised in all the applications of voltaic electricity.

As far as the author has been able to find out, there has not hitherto been any satisfactory means in the hands of the demonstrator of physics by which the existence of the internal current within a single cell can be made apparent. Faraday, in the course of his early researches, made the following experiment: he suspended a magnetic needle by a silk thread and lowered it into the liquid between the plates of one cell of a voltaic battery, so that its length should lie in a plane perpendicular to those of the plates, and he observed that when the needle was just below the surface of the liquid it was deflected the moment that the external current was closed. On lowering it still deeper (the current being maintained complete) its deflection gradually diminished as the depth of immersion was increased, until it reached a position about half the depth of the liquid, when it returned to zero, and after passing this depth it was again deflected, but this time in the opposite direction, its amount of deflection in either case increasing as its distance from the neutral or central point was increased. The cause of this phenomenon is obvious from the following considerations:—If a wire carrying an electric current be held *above* and parallel to a magnetic needle, the latter, obeying Ampere's law, will be deflected with an angular displacement dependent upon the strength of the current and its distance from the needle; and if the same wire be held *below* the needle, the latter will be similarly deflected, but in the opposite direction. Now the flow of electricity through the liquid in a voltaic cell may, for the purpose of this explanation, be looked upon as made up of an infinite number of currents transmitted in a horizontal direction from one plate to the other; and when a magnetic needle is immersed just below the surface of the liquid, all these currents are flowing in one direction below it, and a corresponding deflection takes place; when, however, it is lowered deeper into the solution a certain number of currents are flowing below it tending to

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deflect it in one direction, and a certain number are flowing above it tending to deflect it in the opposite direction, and its permanent deflection is due to the electro-magnetic effects of the difference between the two. When these become equal, as they are when the needle is at the middle of its depth, their effects on the needle are balanced and neutralised, and no deflection takes place, and when that point is passed the currents above the needle are in excess of those below it, and a corresponding deflection in an opposite direction is given to the needle. This is an interesting experiment, but is very difficult to repeat on account of the feeble and unconcentrated nature of the electric currents above and below the needle and the resistance offered to its motion by the liquid in which it is immersed.

Professor Hughes, by placing in the current of a battery an apparatus, such as a clock-microphone, or a key by which an intermittent or undulatory character may be given to its current, and holding one side of a rectangular coil of wire in circuit with a Bell telephone over one of the cells of his three-cell battery, a secondary intermittent or undulatory current was induced in the coil by that portion of the primary circuit transmitted through the cell, and a corresponding ticking was heard in the telephone.

In both these experiments, however, the effects observed must be attributed rather to the external current of the other cells than to the internal current of the cell under experiment; and the author is unaware that any successful attempt has hitherto been made to construct an instrument which shall utilise *the whole* of the internal current of a single voltaic cell for the production of electro-magnetic effects. While engaged in some experiments a few years ago it occurred to the author that if a voltaic cell were divided into two portions, having the zinc element in one portion and the positive element in the other, and the solution contained in the one portion were connected to that in the other by a tube filled with the same liquid, the tube being coiled round a magnetic needle, a deflection of the latter, due to the current within the cell being forced by the convolutions of the tube to circulate around the needle, would be produced when the two elements were connected together, and the apparatus shown on the diagram was constructed. This will be seen to consist of two glass tubes closed at their lower ends with perforated corks through which the ends of the coiled tube are inserted. Within the rectangular coil of the tube was suspended a magnetic needle, and the whole having been filled with diluted sulphuric acid, a plate of zinc was placed in one tube and a stick of carbon in the other. On making connection between them by means of a wire, a slight deflection took place, but owing to the feebleness of the current, the directive action of the earth's magnetism and the friction of the pivot, the instrument was not sensitive enough to be satisfactory, and the author therefore designed the instrument which is exhibited on the table, which consists of two glass test-tubes united together by a small tube about two feet long, and convoluted into two circular coils after the manner of a Thomson's reflective galvanometer. Within the coils is suspended an astatic system of magnetic needles, of which the upper carries a light mirror by which its deflections may be made apparent by the movement of a spot of light on a screen. It may therefore in this respect be looked upon as a Thomson's reflecting galvanometer, coiled with liquid instead of with metallic wires. The elements are placed one in each of the little cells, and may be connected by a key; or, by placing a reflecting galvanometer in the external circuit, both currents may be simultaneously indicated on the screen and their inter-dependence or identity be demonstrated. The first instrument constructed by the author was made by connecting the two cells by means of a tube of india-rubber coiled round two cardboard cylinders, but through the kindness and unrivalled skill of his friend Mr. Gimingham, whose name is now inseparably connected with the splendid researches of Mr. Crookes, he was able to produce the instrument on the table, in which the tubes and coils are of glass, all in one piece, and it is a very beautiful specimen of accuracy of glass-blowing. Below the base of the instrument is a fine slightly magnetised sewing needle, which can be rotated on a vertical axis through a small angle by means of a little lever, and by which the instrument may be adjusted to zero.

The author has been induced to bring the instrument before Section A. of the British Association, in the hope that it may be useful, not only for science teaching, but for aiding investigations connected with the physical action of the voltaic battery.

EDISON'S LATEST TELEPHONE.

SINCE the first appearance of Professor Edison's electro-chemical telephone it has passed through a succession of changes until it has finally assumed the compact and convenient form shown in the accompanying engraving. The form, however, is not the only change. In the first electro-chemical telephone, it will be remembered, the chalk cylinder was supplied with moisture by a movable roller which dipped in the exciting fluid and supplied it with moisture. This movable roller is now dispensed with, and the chalk cylinder is enclosed in a vulcanite box, seen at the end of the movable arm. The cylinder, when once moistened, remains in that condition for an indefinite period, as the box is practically air-tight.

The small shaft that runs parallel with the iron arm extends through the side of the box and carries the chalk cylinder. Upon the opposite end there is a small pinion moved by a worm, the crank of which is turned by the finger. The diaphragm of the receiving instrument is covered by the front of the box, excepting a small central portion which is quite sufficient for the exit of the sound.

The arm which supports the receiving instrument is jointed so that it may be raised vertically out of the way when the telephone is not in use.

The transmitter, fig. 1, is contained in the stationary rectangular box; its mouthpiece projects slightly, and the diaphragm, which is of mica, is supported by a metal frame and springs inside the box cover. This transmitter is quite different from the carbon transmitters now so largely in use in America, and it will be new to many of our readers; but it is one

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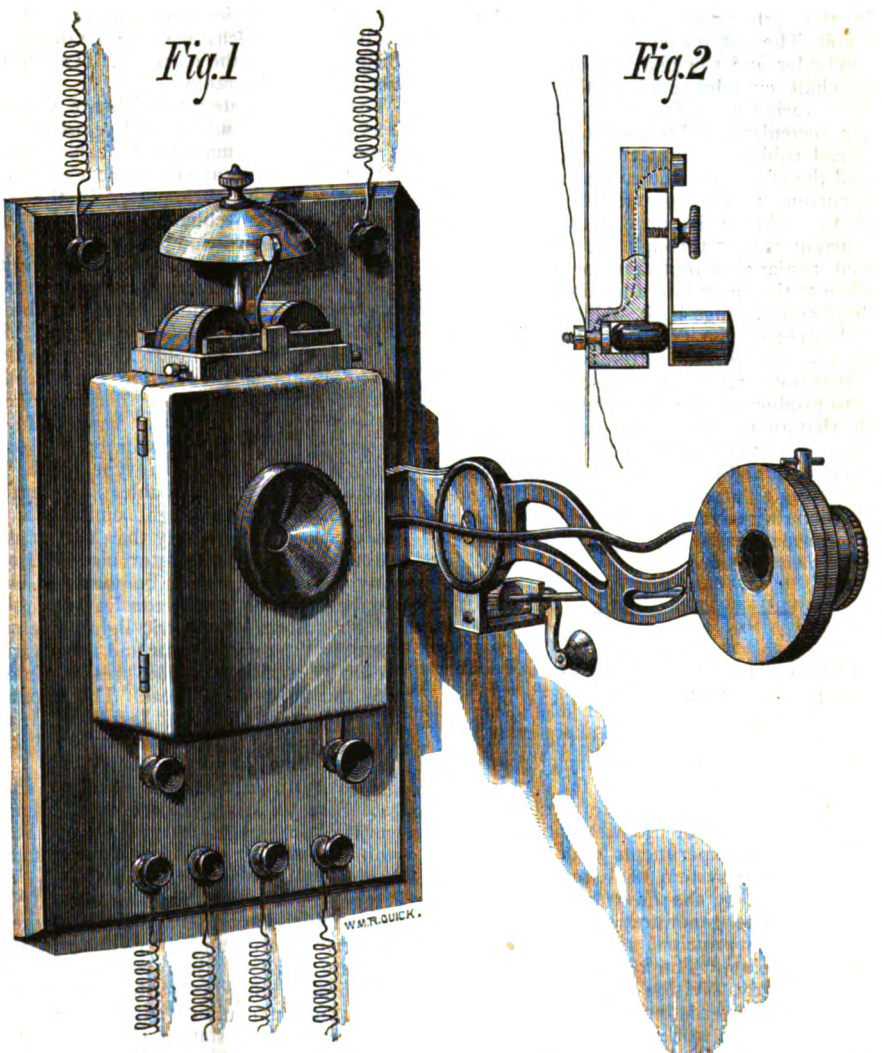
of Professor Edison's earliest and best telephones or microphones. It is exceedingly simple and does not require frequent adjustment, while it is equally as sensitive as existing forms of transmitter. The details of its construction will be understood by fig. 2. A vulcanite arm is secured to the centre of the mica diaphragm by means of a small bolt, which is connected with one pole of the battery by a piece of metallic foil or very thin copper wire. The head



of this bolt is platinum-faced, and sunk deeply in the vulcanite arm, the same cavity containing also a piece of carbon pencil, such as is used for electric candles. The carbon fits the cavity loosely and is rounded at both ends. Its outer end is pressed by a platinum-faced spring secured to the outer end of the vulcanite arm. The spring carries at its free end, exactly opposite the piece of carbon, a brass weight, and the pressure of the spring upon the carbon is regulated by the small set screw. A wire or piece of copper foil, connecting with the spring, completes an electrical circuit, which includes the primary of an induction coil contained by the rectangular box. The secondary wire of the induction coil is connected with the telephonic line, and a tertiary coil which envelopes the secondary is connected with the rubber and chalk cylinder of the receiving instrument. Below the transmitter box are two keys, the right hand one being used for signalling, the left hand one for completing the tertiary circuit when a message is received.

The cylinder of the receiving instrument is made of precipitated chalk solidified by great pressure. The fluid now used to saturate the chalk is a dilute solution of hydrogen disodic phosphate. Professor Edison has found by a long series of experiments that the solution employed must be that of an alkali or the phosphate of an alkali, and the hydrogen disodic phosphate is found to be superior to all others.

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The operation of this telephone will be understood by those who are familiar with the first electro-chemical telephone. The vibration of the diaphragm of the transmitting instrument varies the contact between the carbon and the two electrodes, so that a varying current is sent through the primary of the induction coil; this of course produces a secondary current of varying intensity in the secondary wire of the induction coil, which being in circuit with the secondary wire of the induction coil of a distant instrument produces a current in the tertiary wire wound around the secondary coil. The tertiary current passes through the chalk cylinder and the platinum-faced rubber, and as the chalk cylinder revolves, the friction of the rubber is varied according to the variation of the primary, secondary, and tertiary currents. The platinum-faced rubber is connected with the diaphragm, and the friction of the rubber is sufficient, when no current passes, to pull the diaphragm forward as the cylinder is turned; but when the slightest current is sent through the primary coil, the induced tertiary current transforms the frictional surface of the chalk into a frictionless surface and the diaphragm springs back. All this describes a single vibration of the diaphragm, thousands of which are required for the utterance of a single sentence. It is not essential that the current should be broken to produce the effect in the receiver. It is probable that an absolute break never occurs in the ordinary use of the telephone.

An ordinary call bell is adopted in this system as a means of giving an alarm.

This telephone is unrivalled for loudness of speech, and an electro-magnet is not required in its construction.—*Scientific American.*

THE LONTIN ELECTRIC LIGHT ON THE METROPOLITAN RAILWAY.

ON Monday evening, the 6th inst., at the invitation of Mr. Myles Fenton, General Manager of the Metropolitan Railway, a number of the representatives of the metropolitan press were present at the Aldersgate Street station of the Metropolitan Railway, to witness some experiments with the Lontin Electric Light. The system of Electric Lighting has been carried out by the *Electric Generator and Light Company*. The generator is that known as the "Lontin." The principal advantages claimed for this machine being, "The low speed at which it works," "The ready division of the light," and "The production of alternate currents."

The Lontin machine works at a maximum speed of 400 revolutions, whereas those hitherto employed in public lighting are worked at from double to treble that rate. The great advantages of low speed are the enormous reduction of wear and tear, of risk of accident and of over-heating.

The light may be very much sub-divided. As many as 12 lights have been placed on one circuit. It has been shown practically that by the machine it is possible to give a larger number of small lights, and, so far as experience has hitherto gone, whatever loss there may be in illuminating power is much more than compensated for by the convenience of so complete a distribution; however, curiously enough, up to a point which at present appears to be between 4 and 6 lights on a circuit, it is stated that a positive gain is obtained by division. These experiments are not yet completed, but the cause is no doubt due to the fact that when this limit is reached the internal resistance of the machine is equal to the external resistance, under which circumstance the maximum amount of heat would be produced in the latter, and therefore, the maximum amount of light. A machine constructed nominally for 12 lights (which would mean 12 lights of 600 candles-power each) may be arranged to produce 48 lights, should the nature of its application make such division desirable.

The various patents which are the property of this Company include special regulators and lamps, as well as special materials for cables and insulation, so that the whole apparatus necessary for the purposes of electric lighting used in this system is to a great extent peculiar to itself, and constructed under its own direction and control.

The electrical machine now supplying the 8 lights for the station at Aldersgate Street is similar in construction to the one described in the number of the *Telegraphic Journal* for May 1st, 1879, and is capable of giving 16 lights, of 600 candles each.

The lights at the station are placed two in a circuit, there being four distinct circuits as at present arranged, and the lamps can be lighted or extinguished independently of each other. They are of the Serrin type, with the Lontin modification, which enables a greater amount of subdivision. The light emitted is also much more constant and steady than that of the old form. Another form of regulator also used by the Company can, if necessary, be made to burn for any number of hours continuously.

This system of electric lighting is stated to be not only the most regular and most agreeable commercially available at the present time, but to be also the most economical. The expense of daily working is estimated at less than 3d. per hour for each lamp of 600 candles, from 1 to 1¼ horse-power being required to produce the latter.

The improved machines employed in the Aldersgate Street station have been constructed in the works of Messrs. Harding & Co., of Paris, through whose house this system of lighting has been introduced.

The steam-engine which drives the electrical machines is one of 25 horse-power constructed by Messrs. Fowler of Leeds, and at 112 lbs. pressure is driven at a rate of about 130 revolutions per minute, the generator running at 400 and the inductor at 200 revolutions per minute; it has been placed at the Aldersgate Street station with a view to its supplying the motive power to three or four sets of machines for lighting other stations on the line, as may be desired by the Metropolitan Railway Company. It is proposed shortly to extend the lighting to the Farringdon Street and Moorgate Street stations of the Railway.

The exhibition on Monday was the first public one that has taken place and was for the purpose of showing the progress that the system had made.

Previous to the lights being shown at Aldersgate Street, the press representatives assembled at the Three Nuns Hotel, Aldgate, where a dinner was pro-

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vided, after which the representatives of the Company, Messrs. Harding and Godfrey, explained the object of the meeting, and pointed out some of the peculiarities of the system as regards the mechanism of the lamps, &c. The latter when supplied with carbons, each about 1 metre long, would burn for 15 hours with remarkable steadiness.

The result of the exhibition was decidedly to show the light to be a success.

REYNIER'S NEW ELECTRIC LAMP.

It will be remembered that the principle of the Reynier lamp consists in keeping red hot a small pencil of carbon, by the passage of a current of electricity along a small part of its length, between an end contact on which it abuts and a lateral contact past which it slides in advancing.

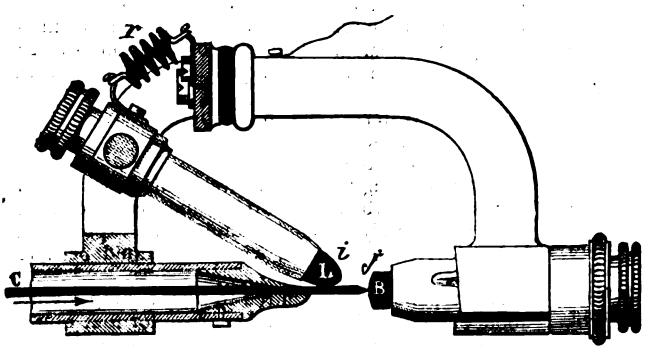

Fig. 1.

Continuing to improve his system, M. Reynier has devised a new and simpler electric burner than before, which will render incandescent lamps of general use. This form is shown in fig. 1, where the carbon C, pushed in the direction of the arrow by any kind of mechanism whatever abuts upon the end contact B; the lateral contact L, shown at the extremity by a lever, leans itself on the carbon by a retracting spring, *r*, and limits between *i* and *j* the incandescence of the pencil.

The end contact B is mounted on a support carried by the lower part of the lamp. In introducing the carbon pencil into the lamp the contact is drawn back.

Incandescence manifests itself between *i* and *j*, over a length which can be varied from four to eight millimetres. The light got is from 5 to 20 Carcel jets, according to the intensity of the current and length of the incandescent piece. With a battery of eight Bunsen elements, of Ruhmkorff's model, a light equivalent to about 12 Carcel jets can be produced. When operating with magneto-electric machines, three to five burners can be lit per horse-power, each equivalent to from 8 to 14 Carcel jets, or from 30 to 40 Carcel jets in all.

M. Reynier has made different lamps to act by counterpoise and by hydrostatic pressure; that shown in fig. 2 represents a style of lamp which acts in a suspended position. In it the progress of the carbon is caused by the descent of a cylinder *p*, which bears directly upon the upper end of the carbon.

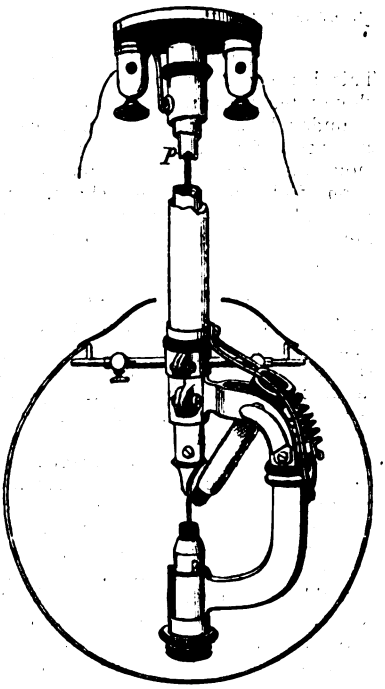

Fig. 2.

On the use of Batteries for Domestic Lighting.

By EMILE REYNIER.

My new electric incandescent lamps, simplified as they are, can furnish from three to five lights per horse-power. They will, therefore, be useful in factories where a motor is installed, for they yield a light equal to from 30 to 40 Carcel jets per horse-power, which is a sensible economy over gas-lighting, while giving a purer light.

Besides these applications they will be able to serve in private establishments if an economic means of generating the current without a motor be provided. With six or eight Bunsen couples, of the flat Bunsen pattern, a fine light of from 6 to 12 Carcel jets is got during four hours. But these batteries are inconvenient owing to the nitric fumes given off. Their expense is also too great, eight couples costing, for four hours, a sum of 5·81 francs,

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which makes each Carcel jet of electric light to cost 0·122 francs per hour.

I have sought to provide a cheaper sort of battery for the purpose, and have tried various batteries, such as the bichromate batteries employed in galvanoplasty; Thomson batteries, recently imported from England by M. Maudet, and experimented with by M. Mascart on electric motors at the College of France; Faure's modified Bunsen, in which the fumes are suppressed; and lastly, the rotating battery of Becquerel, well known to physicists though unused. Our results as obtained by the Reynier lamp are as follows:—

FAURE'S BATTERY.

This battery is composed of a porous pot of agglomerated graphite closed by a carbon bung and surrounded by an ordinary cylindrical zinc. This element thus formed acts like a common Bunsen without disengagement of vapours; but the production of electricity is very slight. It is not our aim to find the cause of this fact, but it may be due to the resistance of the bottles or their insufficient porosity.

THOMSON'S BATTERY.

That tried was composed of 12 pairs, of which the surfaces of the zinc and copper plates were 200 x 200 millimetres. The plates were separated by a diaphragm of parchment paper. These 12 pairs heated a carbon one millimetre in diameter to a white but very feeble light of one candle-power. I estimate that to obtain a current equivalent to that of eight Bunsen pairs, 45 Thomson cells would be required. The cost of these would, of course, be embarrassing. The expense for four hours would be about three francs or 0·062 francs per Carcel jet. This battery is very constant, gives off no fumes, and would act for over 12 hours without requiring to be recharged. On the other hand it is costly and cumbrous, and, although more economical than the Bunsen, is still too expensive for the purpose in question.

BICHROMATE OF POTASH BATTERIES.

The *pile à treuil* of M. Ducretet and M. Loiseau, of 15 pairs did not give good results. The light, bright enough at the moment of immersing the plates, soon waned, and after ten minutes polarisation had fallen to about half a jet. By remounting the pairs one can depolarise them almost at once. Agitation of the liquor causes a partial depolarisation which prolongs the duration of the experiment. Costly, cumbrous, and very inconstant, the battery can only serve for brief experiments.

Eight pairs on Ruhmkorff's model, with porous vases, were tried successively with the following liquids:—

1. Goarant de Tromelin { Interior vase (carbon): acidulated water bichromated. Exterior vase (zinc): Solution of chlorhydrate of ammonia.
2. Poggendorff ... ... { Interior vase (carbon): acidulated water bichromated. Exterior vase (zinc): acidulated water.

The first (Goarant) proved superior to the second (Poggendorff). It does not give off any smell, the zincs consume regularly, and there is no effervescence. The liquid depolariser exhausts itself in two hours, the capacity of the internal vase being about 35 centilitres. It is necessary to nearly treble the number of pairs to give a result similar to that of the Bunsen pairs which last four hours. The same battery, charged with the liquids of No. 2, has not given so good results. The usage of the zincs is not so great; and the substitution for acidulated water of chlorhydrate of ammonia is therefore an advantage. To replace the Bunsen cells by bichromate and chlorhydrate ones, the number of pairs should be increased in quantity, or their surface developed, and their capacity relative to the carbon compartment should be increased.

The expense of a Goarant battery of 24 pairs acting for four hours is 8·85 francs, or 0·18 francs per hour per Carcel jet, which is still too much.

A rotating battery of 12 circular zinc-carbon pairs of 14 centimetres diameter, immersed to a height of 41 centimetres, gave only insignificant results when the liquid was acidulated water or a solution of chlorhydrate of ammonia. With acidulated water bichromated the results were remarkable; the zincs being amalgamated. The rate of rotation was 24 turns per minute. The liquid was composed as follows:—

Water	... 6	kilogrammes.
Acid-Sulph.	1·200	„
Bichromate	0·500	„

At the beginning the battery freely illuminated two lamps with carbons of two millimetres thickness, then more freely a single lamp. The experiment lasted forty-five minutes, when the liquid became exhausted.

Eight pairs were required to light a lamp giving about eight Carcel jets. The expense for four hours came to 5·70 francs, or about 0·18 francs per Carcel jet per hour. This battery therefore, though more convenient and better than the others, is also debarred from use by its cost.

We may add that experiments have shown that 200 Leclanché or 300 Callaud cells are necessary to give a small electric light.

Conclusions.—The most energetic battery is Ruhmkorff's pattern of the Bunsen, but it is inconvenient and deleterious, and too expensive.

The most economic and constant battery is that of Thomson, but it is costly and cumbrous.

The most convenient would be the rotating battery, but the expense would be very great.

A battery as energetic as the Bunsen, as economic as the Thomson, and as convenient as the rotating one would yet be far from answering the purpose.

It is not therefore among the hydro-electric batteries known that an electric generator suitable for domestic illumination by electric lamp can be obtained.—*La Nature.*

THE ELECTRIC LIGHT AT BLACKPOOL.

FAVOURED by the magnificent summer weather of the past week, Blackpool, the most popular watering-place of the North, has been *en fête*, and the inauguration of the illumination, by means of the electric light, of the promenade and the two piers has been marked with

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complete success. In the Improvement Bill obtained during the past session of Parliament, power was granted to the Corporation to devote a sum of £5,000 to experimenting on electric lighting, the amount of the loan to be repaid within a period of ten years. With the well-known enterprise that characterises the local authority, and notwithstanding the advanced period of the season, a committee was appointed, with Mr. Challoner as chairman, to make the necessary arrangements for an experiment in electric lighting on a very large scale, and Dr. Siemens' patent dynamo-electric machine was the one used in producing the light. The town's yard occupies a central situation, and here a wooden shed, 60 feet by 24 feet, has been erected. The dynamo-electric machines are eight in number to produce as many lights, and are actuated by large pulleys on a main shaft, 4 inches in diameter, driven by two patent Robey engines, each of which is 16 horse-power nominal, and during the trials, when the machinery was in full operation, a total of 36 horse-power was indicated, the engines making 114 strokes per minute, with 75lbs. steam pressure on the two boilers. The speed of the generators is 800 revolutions per minute. There are eight lights in all, each estimated to have an illuminating power equal to 6,000 sperm candles, or 48,000 candles on the whole. Six of the electric lamps are suspended from poles at a height of 60 feet from the ground, and are so arranged as to occupy three sides of a quadrangle or square, formed by the promenade and the two piers, the total length of the three sides being about 1,800 yards, and the lamps averaging 320 yards distance apart. The remaining two lamps are fixed on the roof of the Prince of Wales Theatre, which fronts the promenade, and is situated midway between the piers. Movable parabolic reflectors are placed behind these two lamps, by means of which a beam of light can be projected in any direction. From the dynamo-electric machines in the town's yard to the farthest light on the South Pier the wire is 1,300 yards in length, and the distance to the nearest light is 250 yards. A separate leading wire is carried to each lamp, and one common return wire serves for the whole. All these wires are of copper, varying in the number of strands in each, and are insulated with gutta-percha covered by india-rubber. At the commencement of the arrangements for the lighting, the whole of the wires were conveyed to the several lamps in 2-in. and 3-in. cast-iron main-pipes laid under ground; but owing to the unfavourable weather that prevailed during the earlier part of the month, high tides swept the beach and promenade, covering the pipes in some places to a considerable depth, and filling them with salt water. This had the effect of destroying the insulation, and the consequence was the lighting entirely failed. The want of insulation was, probably, not so much due to the action of the water as to the iron of the pipes through which the wires were conveyed, and it will probably be found necessary, in future attempts of a similar kind, to insulate wires by laying them underneath the surface of the ground in glass or glazed porcelain tubes. This portion of the work had, therefore, to be commenced *de novo*, and it is due to those who had charge of the arrangements to say, that instead of being disheartened by the failure of their first attempt, they set about, with redoubled vigour, suspending the wires upon poles throughout the circuit. This was accomplished, and the whole of the work completed and in perfect order for the lighting, which commenced on Thursday evening week. The arrangements from the beginning have been under the charge of Mr. Andrews, the representative of Messrs. Siemens, and Mr. John Chew, the gas engineer to the Corporation, and these gentlemen may be congratulated on the result of their exertions. Mr. Siemens has also given personal attention to the work, and the Electric Lighting Committee of the Town Council have been indefatigable in their efforts. With the exception of a slight occasional fluctuation in one of the lamps, the lighting on Thursday and Friday, the opening nights, was completely successful, the lights burning with remarkable steadiness. Had the lamps on the promenade been increased in number, and so placed nearer together, say at 200 yards apart, the illumination would have been more uniform over the whole distance; but any disadvantage that arose from the width of the lights apart was more than compensated for by the grand effect which was produced by means of the two lamps on the theatre above-mentioned, backed by the parabolic reflectors. By judicious manipulation of these latter, magnificent beams of light were thrown in each direction alternately, the effect being scenic and sensational in the highest degree. In a spectacular sense, the electric light at Blackpool has proved a success. The cost of the machinery and the other apparatus was originally estimated to reach £2,500; it will, however, probably amount to a considerably larger sum. But what of that? It may be said to have been wiped off already! Blackpool aldermen and town councillors are very wise in their generation The thing is a grand speculation, and pays. At this advanced season of the year Blackpool is usually empty of visitors. At present it is full to repletion with 70,000 to 100,000 visitors. Not a room, or even a sofa, is to be had in any of the hotels, from the "Imperial" downwards, unless it has been secured a fortnight beforehand. The lodging-houses, too, are overflowing, and excursion trains from all parts of the country are bringing thousands of trippers into the town, returning them after midnight, each day of the fête, to their respective destinations. But what is the impression it produces upon the mind of the spectator in regard to its effect as a competitor of gas lighting? Simply this, that the latter rises higher and higher in esteem as a useful, easily-managed, and ever-present illuminator. Electricity may be the champagne light of fête days, but coal gas is the Bass's beer light of everyday life; and though the former is not to be despised on occasions, the latter is the wholesomer, not to mention the cheaper of the two, and what most sensible people will prefer to use. It is a noteworthy and curious circumstance that every trial of electric lighting, however successful, only serves to prove its utter general impracticability as a general illuminator, and the impossibility of its ever, in the slightest degree, competing with or interfering with the progress of gas lighting! If gas managers could only be permitted to take the trouble and go to the expense of organising a display of the kind witnessed last week at the northern seaport, nothing would more contribute to prove the truth of the views here expressed, and the utter folly and simplicity of gas shareholders who would timidly dispose of valuable property—about the most valuable in the country at the present hour—at a sacrifice, in fear of such a competitor.—*Journal of Gas Lighting.*

HEINRICHS' ADJUSTABLE DYNAMO-ELECTRIC MACHINE BRUSH-HOLDER.

THE metal brushes which are employed to collect the currents in dynamo-electric machines are more subject to wear and tear than any other parts of the machine, not simply from mechanical friction but also from their being burnt away by the current.

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The waste of the brushes by burning in some machines is greater than can be accounted for by friction only. As the brushes are generally made of copper wire they will wear grooves upon the surface of the commutator, which is very objectionable. The brush-holders which are employed to retain the brushes in the required position on the commutator ought to be so constructed that these brushes can be easily shifted along the length of the commutator, so that fresh surfaces of the latter can be presented to the action of the brushes, and by this means be kept in good order.

Another important point is, that the brush-holders should always press the brushes against the commutator with the same elastic pressure, in spite of the brushes becoming worn. Figs. 1 and 2 show Heinrichs' patent brush-holder, which is so constructed as to embody the before-mentioned points, and also in case of accident this brush-holder will act as a contact-breaker.

Fig. 1 shows the brush-holder and brush, *b* is the usual brush, which can be easily detached from the holder *e*, this holder is fitted to the shaft *s*, and can be shifted along the length of the shaft, also by means of the screw *f* the brush and holder can be fixed on the flat portion of the shaft *s*.

This shaft *s* has on its lower end the worm-wheel w^1, as shown in fig. 2, which is fitted in the base *d*, so as to be capable of revolving in the latter. Into the worm-wheel w^1 the worm w^2 is fitted, by which the former with the shaft *s* can be revolved. The worm w^2 has on its outer end the button *c*.

The steel spring *p* is fastened to the base *d* with the screws *i i*; this spring is slotted on its other end, where it is kept in the groove of the worm w^2 at *g*.

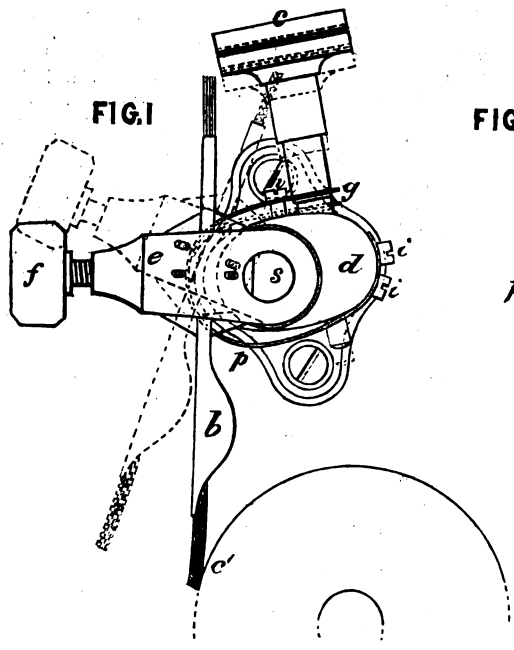
The motion of the spring *p* with the worm w^2 is limited by the stop-screw *h*.

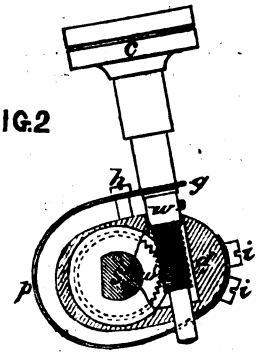
The action of the brush-holder is as follows :—

By turning the button *c* the shaft *s*, with the brush *b* and holder *e*, fig. 1 can easily be revolved. The spring *p* will then be in the position shown by fig. 2, but when the brush *b* comes in contact with the commutator c^1, as shown in fig. 1, by further turning the button *c* the worm w^2 will be screwed into the base *d*, the spring *p* will leave the stop-screw *h* and follow the worm w^2 in the direction of the base, and will act with its elastic pressure upon the worm w^2, worm-wheel w^1, and shaft *s*, thus keeping the brush *b* elastically fixed upon the commutator c^1.

One half of the distance in which the spring *p* is allowed to move between the base *d* and stop-screw *h* is sufficient to keep the brush for weeks in elastic contact with the commutator, in spite of the waste of the brushes.

The second half of the before-mentioned distance allows the brush at any time to be lifted off the commutator at once, as shown by the dotted lines in fig. 1, and thus in case of accident to act as a contact-breaker.





THE ELECTRIC LIGHT ON WATERLOO BRIDGE.

A FURTHER step in the development of the electric light in the metropolis has been effected by the extension of the Jablochkoff system, which has for some time past illuminated the Victoria Embankment, to the lighting of Waterloo Bridge. For this purpose ten lamps had been fitted up with the Jablochkoff electric candle, nine of these being situated on the bridge, and one on the refuge at the Strand end in the middle of the roadway.

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In addition there were five Jablochkoff candles fixed in the machinery shed under the Charing-cross railway bridge, thus adding fifteen lights to the forty previously maintained. Fifty-five lights are now sustained by an engine of 80 horse-power nominal, although there were many persons who doubted whether so many as twenty lights could be kept going. Commencing some months ago with twenty, the number of lights was subsequently increased to forty, now to fifty-five, to be soon enlarged to sixty. Three pairs of machines are now at work, each calculated to sustain twenty lights. Preparations are being made to place four lights in the Board-room of the Metropolitan Board at Spring-gardens, and a fifth over the principal entrance to the building.

The effect produced by the lighting up of the bridge is extremely good, and at the Strand end very striking, the illumination of Somerset House being singularly picturesque. Some of the gas lamps on the bridge are necessarily left alight in order to fulfil the terms of an Act of Parliament which requires that there should be a light over each arch, so as to facilitate the navigation. The absence of these gaslights would have been an advantage to the electric light by allowing the Jablochkoff lamps to present a better *tout ensemble*. But of the practical value of the latter there can be no doubt, and the benefit to the vehicular as well as the pedestrian traffic over the bridge was evident. The whole of the gas lamps are retained on the bridge, as it is not intended at present to maintain the electric light after the period when the four candles contained in each lamp are burned out, which is some little time after midnight. The illuminating power of each of the electric lamps is estimated at 400 sperm candles, subject to a certain percentage of loss consequent on the use of a frosted globe. The latter, however, allows a much larger proportion of light to pass through than occurred when the opalescent globes were employed, as in the earlier experiments on the Embankment, the Holborn Viaduct, and elsewhere. A remarkable fact connected with the Embankment trials is the increasing efficiency of the Gramme machines which generate the electricity. There appears to be no doubt that these machines are electrically improved by use, probably owing to the increase in the amount of residual magnetism. Other causes operate in the same direction, as, for instance, the diminished friction of the machinery as the working parts become more adapted to their functions. The Jablochkoff candles have also undergone some improvement. At all events, the encouraging fact is now stated that the engine has lately been maintaining forty lights with an indicated horse-power which is slightly less than that which was formerly required for twenty lights.

The total length of conducting wire now in use for the whole of the Embankment, together with Waterloo Bridge, is 17 miles 361 yards. When the Board-room at Spring-gardens is fitted up, the total length will be about 18¼ miles. The lighting of the Embankment by this system commenced on December 13th last year, since which date 28,000 of the Jablochkoff candles have been consumed. M. Berly purposes making some experiments shortly with electric candles of large dimensions, giving lights equal to from 2,000 sperm candles up to 6,000, thus showing that the Jablochkoff system can give a highly concentrated light if desired.

THE BRITISH ELECTRIC LIGHT COMPANY are still prosecuting their experiments in lighting the Picton Reading-room by the Werdermann lamp.

Notes.

THE INTERNATIONAL EXPOSITION OF THE NETHERLANDS, held at Arnheim, has awarded a gold medal to the Société Générale for the Jablochkoff process. The same light has also been tried at the Marseilles docks in unloading ships; and it is likely to be adopted in several towns in the Province of Oran, Algeria, which do not possess gas-works.

THE SUN ELECTRIC LIGHT COMPANY of 19, Great George Street, Westminster, has issued a prospectus offering 500 shares of £5 each. The preliminary capital is £5,000, in 1,000 shares of £5 each; and the liability of each shareholder is limited to the amount subscribed. Only 100 shares will be issued just now, the remaining 400 being issued after the light has been publicly exhibited, which will probably be during this month. It is claimed for the Sun lamp that it will give a light equal to 1,000 standard candles, at a cost of less than 2d. per hour.

THE ELECTRIC LIGHT IN BURMAH.—The *Times of India* says: "An extensive business transaction has just been concluded between the Indian Electric Light Company and the King of Burmah. Attracted by the experiments which have been made in this country with the electric light, King Theebaw sent an agent over to Calcutta to purchase the largest portion of the company's machines and plant in Calcutta and Bombay, including the apparatus that was lately employed in illuminating the Hooghly Bridge. The Burmese agent paid down 80,000rs. in hard cash, and we are informed that the entire cost of the lights—forty of Jablochkoff's and eight of the Regulator system—and fixing them in the Royal Palace and gardens at Mandalay will be no less than 1,000,000rs.

THE experiments in electric lighting on board the Invincible, are for the purpose of dispensing with the ordinary lamps in lighting the ship, and not for torpedo work.

THE promenade and piers of Blackpool have been lighted by six Siemens' lamps. Great numbers of spectators have been attracted to the town to see the fine effect. See page 336.

AN amusing freak of lightning is chronicled by our contemporary *L'Electricité*. It appears that a French railway porter was recently engaged in the grateful task of frying a savoury omelette over a stove placed beside his door, when a flash came which knocked the frying-pan out of his hand, sent the stove-pipe, the cinders, and the stove itself flying in all directions, and at the same time polished the sooty pan till it shone like the helmet of Don Quixote. As for the omelette, it was never seen more.

BELL TELEPHONE EXCHANGES.—Considerably over 50 subscribers have now been obtained in London to this system of vocal communication, including telegraph companies, banks, insurance companies, shipowners, stock-brokers, and merchants. Over 80 have been gained in Manchester, and over 40 in Liverpool.

THE MICROPHONE AND DEAF PERSONS.—The distinguished experimenter, M. P. Bert, has set himself the task of making persons dull of hearing to hear distinctly by means of a new fashion of microphone. With the aid of M. Arsonval, M. Bert has constructed one which permits a deaf person to hear a speaker at

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any distance, the apparatus being placed about a yard and a half from the speaker. Among other improvements, it can reproduce sounds with an amplitude proportional to that of the emission, and with their proper timbre.

Mr. F. W. JONES, of the Western Union Telegraph Company, is reported to have devised a means of eliminating the effects of telephone call signals on lines comprising several telephone stations. This consists in an arrangement for shunting the current at intermediate stations by means of a coil of fine wire so wound as to neutralise self-induction. This is connected round the magnets in the telephone circuit through the local points of the instruments, so as to form a shunt or branch circuit when the line is used for speaking, and to be removed when the line is used for signalling.

EDISON'S telephone, of the form illustrated on another page, is giving great satisfaction in France, where it has been tried at the Central Telegraph Administration and on several railway lines. The Administration experiments were undertaken at the request of M. Cochery, minister of posts and telegraphs, and they were made between Paris and Versailles, a distance of 13 miles, and on other shorter suburban lines. Although more than 100 sets of Morse and Hughes instruments were at work in the same room, and ordinary traffic was passing over the wires next to the telephone circuit, the Edison apparatus is said to have done very well. On the Northern Railway, M. Lartigue, the engineer, has installed a loud-speaking telephone from Paris to Creil, a distance of 31¼ miles; another, *viâ* St. Quentin, a distance of 40 miles; and a third from Paris to Amiens and returning to Creil, a length of 142 miles. On the first two lines the vocalisation is all that could be desired, but on the longer one it is feeble, and speakers require to raise their voices, and sometimes to repeat, in order to be heard. On the Eastern Railway several shorter lines, as from Paris to Meaux, a distance of 25 miles, have been fitted with these telephones successfully.

THE TELEPHONE.—Experiments that I have recently made with a "Bell" telephone have convinced me that the sounds produced are the result of molecular change in the iron disc, and are the same in kind as those heard in the telephone of Reiss. My experiments were made with a carbon transmitter and Bell receiver, using a small battery to generate the current. First I removed the bar magnet from the receiver, in accordance with a suggestion made by a writer in *Nature* some months ago. The effect without the magnet was the same as with it. It then occurred to me that the intensity of the sound might be increased by using two discs instead of one. Accordingly I cut two circles out of a piece of sheet iron, leaving a narrow strip of the metal to connect them, of sufficient length to enable the discs to lie on either side of the reel, so as to form, in fact, an armature to the electro-magnet. On experimenting with this my anticipations were fully realised, the sound produced being more than double that from a single disc. Now, while trying these experiments I held the discs loosely in my hand, without their being in any way fastened to the wood holding the reel, the effect being the same as if firmly secured. In fact, a common dinner-knife or a rough piece of iron would emit sound if brought near enough to the core of the electro-magnet. I have since constructed a very efficient telephone receiver out of a block of wood two inches square and three-quarters of an inch thick. I then drilled a hole sufficiently large to receive the reel, and covered the block with thin sheet iron. It needs no ear-piece, and forms the most effective telephone receiver that I have seen. But, still further to prove that the sounds produced are due to the magnetisation of the iron of the disc, and not to mechanical vibrations resulting from the electro-magnet, I made an iron reel, the flanges of which were two inches in diameter. Now, on covering this reel and placing it in circuit, the flanges of the reel gave out sound as clearly as in the Bell telephone. In my judgment this experiment renders it conclusive that the sounds proceed from the magnetisation and demagnetisation of the iron, and are therefore precisely the same in character as those formed by a Reiss receiver.—PERCIVAL JENNS (of St. John's Rectory, British Columbia), in *Nature*.

EDISON'S telephone has been put in operation at the carbonate mine of Leadville, Colorado, to give orders from the pit head to the underground galleries. The electric light is also to be applied to the working of that mine. The moist chalk cylinder of the motograph receiver in this telephone has been replaced with advantage by a perfectly dry one.

TELEPHONE EXPERIMENTS WITH AN OPEN CIRCUIT.—Mr. J. E. Watson, of Louisville, Kentucky, has sent us an interesting account of some experiments he has recently made on the transmission of sound by means of the Bell telephone connected up with an induction coil in open circuit. The apparatus consisted of a battery, a vibrating contact breaker, and the primary of an induction coil, connected up in circuit; one end of the secondary of the induction coil was left insulated in air, and the other was extended to a point some 200 feet away by means of a wire, and there joined up to one terminal of a Bell telephone, so as to take the telephone beyond the limits of induction. This arrangement left one end of the coil of the telephone free, and one end of the secondary coil free, so that the circuit was interrupted by a gap of air 200 feet wide. Now, on placing the telephone to the ear, it is possible to hear faintly the humming of the vibrator at the remote end of the wire, although the circuit is apparently broken. By wetting the finger and putting it on the free terminal of the telephone the sound was increased tenfold, thereby showing the partial circuits to be made, not through the air, but through the hand and body of the listener to earth. Mr. Watson also transmitted articulate and musical sounds under similar circumstances, employing instead of the vibrator, a transmitter of his own design, in which a diaphragm vibrated by the voice compresses a small pile of powdered gas carbon and brass filings connected in circuit with a battery and induction coil. In this case the breach of circuit was six feet of air space between the earth plate and "earth."

CAPITAL PUNISHMENT BY ELECTRICITY.—Certain German writers who have for a long time reprobated the brutality of ordinary modes of capital punishment, have at length hit upon a scheme which satisfies their sentimental cravings. In a dark room, draped with black, and which is lighted by a single torch, the chamber of execution, there shall stand an iron figure of justice, with her scales and sword. Stern justice is popularly supposed to have no bowels, but this German version will contain a powerful electric battery in her inside; and this battery will be connected to an arm-chair, which is the seat of death. In front of the chair shall stand the judge's tribunal, and only the judge, jury, and other officials of the jail shall be present with the condemned during the ceremony of execution. This will consist in the judge reading the story of the crime committed by the prisoner, who will be rigidly

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manacled to the aforesaid chair, and when this has been done the judge will break his rod of office and toss it into one of the scales of the figure of justice, at the same time extinguishing the solitary torch. The descent of the hand will complete the electric circuit and shock the wretch into the next world. In truth this would be a solemn, mysterious, and dreadful death, and its conception is worthy of the genius of Edgar Allan Poe.

THE Institute of International Law, now in session at Brussels, has voted in favour of a resolution recommending that the various states agree that the destruction or injury of submarine telegraph cables is an offence against the law of nations.

AN ELECTRIC SUN-DIAL.—A simple *merveille* which, for want of a better term, we may call an electric sun-dial or solar alarm, has been designed in France. It consists of a lens which concentrates the sun's rays on a metal stem, which expands by the heat and closes the circuit of an electric bell, which thereupon rings. The lens can be set so that the sunlight strikes it at any pre-determined hour of the day; and the apparatus will act although the solar disc be obscured by clouds, just as a time-gun will be fired by the focussed heat-rays, although the day is cloudy.

OTHER applications of electricity are reported from France. One consists in catching birds by enticing them to perch on an artificial tree all wound with copper wire and sending a strong induction shock through the wire sufficient to stun them for a time. Another has for its aim nothing less than the destruction of the *phylloxera* insect, which is ruining the vines of the Rhone Valley. This is to be effected in a similar manner, by administering a strong charge to the stems of the vines. So much for the process as seriously given by a contemporary. As for the effects, we should say they would be *nil*.

PLOUGHING BY ELECTRICITY.—Singularly interesting experiments on ploughing by electricity took place on October 5th at Noisiel, in the park of the well-known deputy and chocolate maker, M. Menier. Some people object to M. Menier, that he is fond of keeping his name before the public, but I think there are not many public men who do so in a manner more honourable to themselves; or who, possessed of wealth, are more ready to encourage scientific discoveries calculated to confer benefits on the community at large. This is notoriety of the most creditable kind, and it is not given to every one to achieve it. The motive power was supplied to the plough by a Gramme machine, itself set in motion by water power, which is abundant on M. Menier's estate. The plough did about the same work as if it were drawn by four oxen. It was a Fowler plough, with six shares. The motive power was supplied to it by a wire at a distance of seven hundred metres. I regret that my want of scientific knowledge prevents my giving you a detailed description of this experiment, but it was very wonderful of its kind. To a profane looker-on it was amazing to see a plough propelled by an unseen agency without teams or steam. The Gramme machine employed was the same that supplies M. Menier's manufactory with electric light.—*Standard*.

THE CITY AND GUILDS EXAMINATIONS IN TELEGRAPHY.—The City and Guilds of London Institute for the advancement of technical education have determined to afford facilities for carrying out examinations in a number of technical subjects wherever a class for instruction is formed, or a sufficient number of candidates present themselves, provided a local committee undertakes to carry out the examination according to the rules laid down. The committee of any art or science school under the Science and Art Department or any School Board, or any "Local Examination Board" connected with the Society of Arts, will be accepted as a suitable committee for carrying on the examinations, which will be in three grades: the Honours intended chiefly for foremen, overlookers, &c., the Advanced for journeymen, and the Elementary for apprentices; but candidates may enter themselves in any grade they choose. Certificates and prizes are awarded to the successful students, and teachers will be paid in accordance with the rules of the Science and Art Department for a similar purpose. The examination for 1880 will be held in May next on the same evening as is fixed for the examination in nautical astronomy by the Science and Art Department. The programme for 1880 has been issued, and among the subjects prescribed we may mention blow-pipe analysis, electro-metallurgy, photography, iron and steel manufacture, and telegraphy. Mr. W. H. Preece is examiner in the latter subject, and for the full technological certificate in it the candidate will be required to have passed at least in the elementary stage of one of the following science subjects: theoretical mechanics, applied mechanics, acoustics, light and heat, electricity and magnetism, and inorganic chemistry.

A THERMO-ELECTRIC FIRE-ALARM has been patented in Germany by Herr Tehnder. It consists of a series of brass and iron wire junctions, one set of which are exposed and the other protected from any sudden rise of temperature that may take place. The thermo-electric currents set up by a rise of 15° in temperature are made to operate an electro-magnetic relay and actuate an alarm-bell.

THE BATTLE OF THE AMERICAN TELEGRAPH COMPANIES.—The rivalry of the Western Union Telegraph Company and the new American Union Company, which is about to compete with it on a large scale, is assuming an acute form. The stoppage of the building of the lines of the latter company through Philadelphia has not yet been overcome; but the erection of lines is going on vigorously in other quarters, such as Vermont and the west. Poles are erected at the rate of three miles a day, the men living in tents. Says the *Operator*: "The most determined effort to impede the progress of the American Union was that made through New Jersey, other lines being apparently allowed to progress without much opposition. The Buffalo line, however, was bitterly fought step by step throughout the State by the Western Union, the American Union not being permitted to put up a pole without encountering opposition. The most decided opposition was made at Buffalo, the Western Union exerting every effort, but without success, to defeat the new company in getting a grant from the city to put up poles. The American Union erected their poles, notwithstanding the obstacles thrown in their way by the Western Union people. The poles were cut down and the wires were clipped in the night time. The most determined fight was shown when the American Union labourers on Friday last, September 12th, reached the corner of Seneca and Pearl streets. Here the American Union men put up a 65-foot pole, so as to pass over the wires of the Western Union Company. After getting the pole up on Friday night they went home. At midnight the manager of the American Union learned that the Western Union Company was hoisting new poles about 20 feet either side of the 65-foot pole. He quickly gathered his men, and they

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began stringing their wires. The Western Union employés cut them as fast as they were run over the poles, and things began to grow warm. Hard words were used, and it looked as though the opposing parties would come to blows, but the police interfered and things remained quiet until about noon on Saturday. The American Union Company kept a man on the high pole all day to prevent its being cut down, and the Western Union Company had a man at the foot with a large axe to fell it as soon as the other man should come down. Both companies had large gangs of men on the scene. Words were continually exchanged, and about 3 p.m. were followed by blows. A Western Union man called an American Union man insulting names, whereupon the offender was knocked down. This was the signal for a general fight, and for a few minutes matters were exceedingly hot. A revolver was drawn, and hatchets, vices, nippers, &c., were freely and dangerously displayed. A large police force was soon on the spot, and the affray was broken up. Twenty-one men were arrested, including the chief operator and line superintendent of the Western Union, and the gang boss of the American Union. They were taken before the Police Court and admitted to bail. No serious injuries resulted from the fracas, except that one man had his arm cut with a hatchet. The police took possession of the ground, and no further disturbance is expected, as the authorities will not allow work to go on until the difficulty is adjusted."

M. LE ABBÉ LE DANTEC has constructed an electric machine which gives double the force of the Carré machine. Sparks 15 centimetres in length can be obtained from it.

ELECTRICITY AND HEAT.—In a series of experiments recently described to the Vienna Academy, Professor Von Waltenhofen has sought to deduce from a direct measurement of the work done in induction of an electric current in a closed circuit of given resistance the mechanical equivalent of heat. For induction a magneto-electric machine was used, whose electromotive force was ascertained to be proportional to the number of revolutions. A dynamo-metric handle of the newest construction was attached, and it was furnished with an arrangement for receiving work-diagrams. The induced currents were measured by means of a tangent galvanometer. The results were found to be in satisfactory agreement with Joule's equivalent.

INFLUENCE OF ELECTRICITY ON VEGETATION.—We recently recorded the interesting fact, demonstrated by the experiments of M. Grandeau at Nancy, and M. Leclerc at Mettray (Indre-et-Loire), that electricity in the atmosphere has a fostering effect on plants, such as maize and tobacco. Another experimenter, M. Ch. Naudin, has taken up the matter, and he finds from similar observations in other species of plants in another place that the declaration of the foregoing gentlemen is too general in its character, and that although electricity in the atmosphere is necessary for vegetable growth, just as heat, light, and other agents are necessary, different plants behave themselves in its presence in different ways. His studies were made at Antibes in the large botanic garden there, and he found that plants of bean, lettuce, cotton, and tomato grown under a metal case which screened off the electricity of the air from them grew faster than similar plants grown in the open air, a result in direct contradiction to those obtained by MM. Grandeau and Leclerc.

THE ELECTRIC CURRENT IN AN OPEN CIRCUIT.—If one pole of a powerful battery be put to earth and the other connected with a long insulated wire a feeble continuous current can be detected in the conductor by means of a galvanometer in circuit between the wire and battery. This is explained on the theory of Ohm by leakage from the wire into the air, and by its supports to earth. The tension at the surface of a wire whose conductivity is great will establish itself more quickly than at the surface of a poor conductor, other conditions being equal. Consequently, if Ohm's principle be true the loss of electricity and the current will be more intense in a copper wire than in an iron of the same dimensions. M. Van der Vleit, guided by his own ideas, has arrived at the opposite conclusion, namely: that the current should be more intense in the copper than in the iron wire. To submit his conclusion to the decision of experiment he has operated on wires of iron and copper of 0·2 millimetres diameter and 5120 metres long, stretched in the gallery of the University of St. Petersburg for more than 256 metres. They were supported by hanks of cotton steeped in paraffin. A very sensitive Wiedemann galvanometer, with an astatic needle, was employed to measure the currents. Some 94 per cent. of the figures resulting from a great number of experiments were in favour of M. Vliet's view, the iron wire giving a current 25 per cent. stronger than that of copper.

STANDARD CONDENSERS.—In a paper read before the British Association at Sheffield, Dr. Alexander Muirhead pointed out that there is no one authorised to certify the correctness of the various electrical standards, and made a suggestion to the effect that some public body, such as the Special Committee of the British Association or Kew Observatory, be asked to undertake the labour of comparing resistance coils, condensers, and absolute electrometers with the standards to be lodged in their keeping by the B. A. for that purpose. B. A. units of resistance are comparatively common, but there are no recognised B. A. standards of capacity; indeed, as a matter of fact, most of the condensers now in use in England, and at cable stations, were made by comparison with standards copied from a one-third microfarad condenser made by Dr. Muirhead of tinfoil leaves, separated by plates of mica coated with shellac which had been purified with absolute alcohol. During nine years, as found by Mr. Hockin, the capacity of this condenser has apparently not changed more than one-third per cent.

ELECTRIC JEWELRY.—The ingenious M. Trouvé has brought out another elegant and amusing toy in the shape of *bijoux électriques*, consisting of scarf-pins, brooches, and other ornaments of attire actuated by electricity. Death's heads are made to grind their teeth and gleam in their eyeless sockets; tiny hares are made to beat a tattoo on drums, and golden birds to flutter their bejewelled wings. All this is done by a small battery, of the size of a cigar, carried in the pocket of the wearer. When in a vertical position the Lilliputian battery is at rest; when turned over on its side, the current is let on and the fun begins.

NEW APPLICATION OF ELECTRICITY.—The Tientsin-Taku telegraph line, in China, has already been found useful by the mandarins. The poles afford a most convenient site on which to hang the decapitated heads of highway robbers. A pole at Sheng-Shui-Ku was recently embellished with a neat bamboo cage, containing the head of a thief, whose offences were fully set forth in a proclamation below.

The telegraph line to Yezd has just been completed, and great credit is due to General Herr Schwendler for the execution of the work in so short a time after its

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commencement, in spite of the several serious impediments that had to be encountered. It is said that General Schwendler had promised His Majesty the Shah that he would open the line by the first of Ramazan: a promise now fully realised. It is believed that a "Khalat" awaits the energetic young general on his return to Teheran.

ELECTRIC EXCITATION OF THE HEART.—A series of experiments made recently by two French physiologists, MM. Dactre and Morat, have led them to conclude that the cardaic rhythm is not due to an automatic or reflex mechanism, as is commonly taught; but to a property of the muscular tissue of the heart, or of the nervous ganglions at its termination.

New Patents—1879.

3697. "Electric lamps or regulators." A. M. CLARK (communicated by J. M. A. Gerard-Lescuyer). Dated Sept. 15.

3750. "Improvements in electric lamps and in mechanism for electric lighting." H. J. HADDAN (communicated by C. F. Brush). Dated Sept. 18.

3777. "Electric lamps." J. BROCKIE. Dated Sept. 19.

3793. "Improvements in apparatus and application thereof for producing and subdividing the electric light." J. HARROP. Dated Sept. 20.

3843. "Electric signalling apparatus." A. M. CLARK (communicated by W. Haddan). Complete. Dated Sept. 24.

3875. "Improvements in electric lighting and in the means or apparatus employed therein." C. W. HARRISON. Dated Sept. 25.

3927. "An improved galvano-plastic process and improved apparatus in connection therewith." W. E. GEDGE (communicated by E. Bonez). Dated Sept. 30.

3931. "Call or signalling apparatus employed in connection with telephones." J. H. JOHNSON (communicated by C. Ader). Dated Sept. 30.

3943. "Improvements in the means of obtaining electrical currents and in the application thereof to the utilisation of materials employed therein and in the obtaining products therefrom." A. GUTENSOHN. Dated Oct. 1.

3959. "A medico-galvanic electrode, magnetic at will." J. L. PULVERMACHER. Dated Oct. 2.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

684. "Apparatus for producing light by electricity." M. A. WEIR. Dated Feb. 20. 6d. This consists in producing electric light by allowing powdered substances to pass across the arc between two electrodes in such a way that the electrodes may act on the powder many times. For this purpose the electrodes are arranged in pairs, parallel to, but separated from each other by an extremely small distance (preferably not more than the diameter of the grains of powder) and with or without an insulating substance between them, and then by folding these pairs of conductors upon each other, or by winding them in pairs upon a mandril or otherwise, an extended surface forming a kind of grid of any required shape is obtained, each alternate bar or rib of which is part of one electrode and the next rib part of the other. This grating or ribbed surface is set at an angle to the horizon, and the powder allowed to fall down its inclined surface like a cascade. The powder comes into contact with the electrodes, causing intermittent sparks between and getting white hot, the total effect being a brilliant but soft light. The apparatus may be employed in a vacuum, or a gas, such as nitrogen and carbonic acid, which will not support combustion. Carbon is found to make a good powder for the purpose.

781. "Electric telegraphs." E. A. COWPER. Dated Feb. 26, 1879. 2d. This describes an improvement on the writing telegraph, patented in Patent No. 2385, June, 1878, whereby the receiving pen is actuated by galvanometer needles instead of movable cores in hollow electro-magnets. *(Not proceeded with.)*

863. "Electric lamps." C. D. ABEL (communicated by J. C. Jamin, Paris). Dated March 4. 6d. This describes Jamin's electric candle, consisting of two upright rods of carbon side by side with air between, as in Wilde's well-known candle, the arc forming at the top according to Ampere's law. The conducting wire is made to loop over the arc and divert the latter or draw it out to a point. Various arrangements of the arc and circuit are described. In two conducting wires are made to run parallel with the carbons till they turn off at a certain point at right angles to the latter. The arc therefore passes between the carbons at a point near this, and the carbons are burned into two parts. The upper parts of the two carbons being supported loosely in tubes will then gradually descend as they are consumed, while the lower parts remain practically unconsumed. By another plan a solenoid is placed opposite the arc of an ordinary electric lamp, to draw it out to a point against a piece of lime or other refractory body.

806. "Telephones." J. IMRAY. Dated Feb. 28. 2d This consists in dispensing with the diaphragm of a receiving electro-magnetic telephone by substituting a strained iron bar connected to a sounding-board. The bar may pass through the middle of the coil and be loaded at the end or pressed on by a weight or spring, or subjected to the torsive action of a weight or spring, or it may be bent into a curve, its curved ends being put under strain by the pressure of a board or plate. *(Not proceeded with.)*

801. "Auto-quinetic telegraph apparatus." LUIS M. DE B. Y. O'LAWLOR. Dated Feb. 27. 4d. This consists in employing positive and negative currents on a single line, the positive currents being for changing the apparatus and the negative for signals. A polarised receiving instrument is used to utilise the currents. See Patent No. 1303, 1876. *(Not proceeded with.)*

740. "Electric lamps." F. MORI, C. E. HALLEWELL, W. MILNER, W. GRIFFIN. Dated Feb. 24. 6d. Switching the current in electric lamps from one pair of carbons to the next by an automatic commutator set in motion by spring or other motor, and kept stationary when necessary by other springs or stops, the action of which is determined by the waste of carbons by means of clock-work mechanism.

783. "Obtaining electric light." G. P. HARDING. Dated Feb. 26. 6d. A pencil of carbon in a sheath of lime or other refractory earth is heated by passage of an electric current, and the lime gives off a brilliant light. Instead of the carbon a metal conductor may be used in conjunction with a regulator to keep it from fusing.

792. "Electric telegraphs." Sir C. BRIGHT. Dated Feb. 27. 6d. Instead of bringing the needle or moving

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part of a telegraph receiver to zero by the ordinary means, it is proposed to do so by allowing the current to act simultaneously on an auxiliary armature, which is connected to the signalling magnet. When no current is passing through the conducting wire the auxiliary armature keeps the signalling one at zero by the connection, but passage of a current frees the signalling magnet from the other. The auxiliary one may be made to operate a local recording circuit.

General Science.

ARAGO's statue was unveiled at Perpignan on Sept. 20th. It represents him in the act of speaking, with his arm extending towards the heavens. M. Paul Bert delivered the customary *éloge*, in the course of which he said that: "To contemplate Arago under all the aspects that may attract the admiration of posterity, we must think of him as a man of science overturning the Newtonian hypothesis of the emission of light, determining the physical constitution of the sun, explaining the scintillation of the stars, the nature of the aurora borealis, discovering magnetization by currents, the origin of the electric telegraph, extending to all bodies magnetic properties; finally, for I must limit myself to the most prominent points, indicating to the most eminent of his disciples the star still unknown and invisible, whose discovery introduced order among the perturbed planets, and which still remains the most extraordinary mark of the power of human genius. As a professor, again, before three thousand auditors at the Observatory, or in his chair, as Perpetual Secretary, writing his incomparable scientific notices, or dictating, when blind, his popular astronomy, always, by speech or by pen, marvellous for his clearness, his accuracy, his power and fulness, elevating all he touched, returning to the astonished inventor his discovery developed and fertilised, sowing broadcast his ideas, and rejoicing when others, friends or foes, were enriched by the precious fruits of his genius. As a scientific historian, he excelled Condercet, equalled Cuvier and Fontenelle, and was characterised above all others by his eagerness to give every one his due, and his jealous love of justice. As an orator, he carried into the tribune the vigour and clearness of the scientific chair, vivified by the emotions of a master-spirit, and dominating the assembly by his lofty stature, with his beautiful Southern head, and his eye full of fire. He was a man, in fact, in whom the will to act was united with the consciousness of power, an intelligence marvellously comprehensive and powerfully creative, so bold and yet so prudent at times that it never committed an error that required to be retracted. Of an ardent but loyal nature, ready for power, but incapable of hatred, and thirsting for justice, he had a heart sensitive and valiant, sometimes drawn, says a contemporary, to show itself severe to the strong in order to support the weak; a soul austere, but a brow serene; a father and citizen worthy of the ancient legends, and able, like Carnot, on quitting life, to bear the noble witness: 'My hands are clean and my heart pure.'"

SIGNALLING BY BALLOON.—At the recent inauguration of the Thiers statue some experiments were made to ascertain from what height and distance signals could be transmitted from a balloon. The aëronauts made the signals with a flag, which were received on the earth four miles away by observers there stationed, and translated, the Morse alphabet being used for the purpose. The results obtained show that there would be little difficulty in the inhabitants of a beleaguered city communicating with the outside world if it were possessed of a captive balloon, by means of a set of signals previously agreed upon.

FUEL OF THE FUTURE.—According to the *Mining World*, the time is near at hand when water-gas (hydrogen and carbonic oxide) will come into general use, replacing coal for domestic purposes, in cities at least, and in many metallurgical operations. It has also seemed probable that, enriched, it would supplant the coal-gas now in general use for illuminating purposes, though, as the time seems approaching when electric lighting will be so perfected as to supplant gas, it is probable that the question of fuel-gas is a far more important one than that of illuminating-gas. It has been fully proved that enriched water-gas is a cheaper and much better illuminant than coal-gas, and is in no respect more dangerous.

ANIMAL RUBBER.—A small insect of the *coccus* family, known as the *neen* insect, which yields a gum like india-rubber, has been discovered in Yacatan.

NORWEGIUM is the name given to a new metal discovered by Dr. Tellef Dahll in a sample of copper nickel from Kragerö. The metal is brownish white, and it is of the hardness of copper. The melting point is 350° C., the sp. gr. 9·441, and it oxidises in the air.

PHOSPHORESCENT PHOTOGRAPHS.—To Mr. Woodbury's inventive ingenuity we owe this plan, which has been tested, and is a practical success. The method he employs is known as the "dusting-on" process. It consists in coating a plate with a preparation of dextrine, honey, and bichromate of ammonia which, exposed under a negative, becomes hardened, where it is subjected to the action of light, through the transparent parts of the negative, remaining tacky where it is protected from the action of light by the denser parts of the negative. After exposure under a negative, the film, as it will be seen, is tacky in the lights of the picture, but hard and dry where light has acted on the shadows. The lights are therefore adhesive and tacky, retaining any fine powder which is dusted in or rubbed into the moist surface. At this point comes in the essential novelty. The powder to be used must be a phosphorescent substance. One of the best known and available is sulphide of calcium. A powder of this substance is applied to the image formed on the adhesive film, and sticks to it in due gradation of the tackiness, as regulated by the action of the light which passed through the negative. An image of sulphide of calcium is thus formed, which, the powder being nearly white, is scarcely visible by daylight, but if the image be submitted for a time to sunlight, or bright daylight, or brilliant artificial light, and then taken into the dark, presents a luminous picture, somewhat startling, indeed, in the case of a portrait. A variety of substances possess this phosphorescent quality: sulphides of barium, calcium, and strontium displaying it in the most marked degree; fluorspar, carbonate of lime, pearls, diamonds, phospate of lime, and arseniate of lime.

FLASHING SIGNALS.—A flashing signal apparatus has been in use for several years in the German navy. As constructed at Spandau, in the workshops of the Government, it consists of a reservoir of air compressed to 10 atmospheres, with a reservoir of petroleum communicating with it by a valved tube and a spirit lamp. By means of a valve arrangement, an air current is

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allowed to drive the vapour of the petroleum into the flame of the spirit lamp, when a brilliant flash is the result. Such flashes are controlled according to code.

WELDING METALS.—It has been found by Mr. C. A. Fawsett, of Glasgow, that if a piece of silver, centimetre square, is heated on the inverted lid of a porcelain crucible, to about the temperature of (932° F.), and the end of a thin platinum wire is brought into contact with it, the two metals will be found to have welded to that extent that the silver may be raised from the lid and will remain attached to the platinum wire when cooled off. Mr. Fawsett reports that other metals—copper and aluminium, for example—will likewise adhere to silver.

TAR COLOURS AND THE ELECTRIC LIGHT.—In *Die Chemische Industrie*, Dr. Greiff contends that, should gas manufacture ultimately be superseded by the electric light, aniline colours could be prepared from the residues left on rectifying the petroleum of the Caspian regions. These are estimated at 120 million kilogrammes yearly, and are ten times richer in benzol, and five times richer in anthracite than is coal tar. American petroleum will, doubtless, also prove a rich source of aromatic compounds.

NICKELISING WITHOUT ELECTRICITY.—According to the *Moniteur Industriel*, so much of a salt of nickel is introduced into a 5 or 10 per cent. solution of zinc chloride till it assumes the ordinary colour of a nickel-bath. The articles to be coated, previously well cleaned, are laid in this solution, and the process is complete in from half an hour to an hour. Cobalt can be deposited in the same manner.

COARSEGRAINEDNESS OF WATER.—From a lengthened series of experiments M. Hermann Herwig concludes, that no two contiguous molecular layers of water can be *more* than 1·86 of a millionth of a millimetre apart, and that the same is true also of the mean distances between the centres of adjacent molecules. Sir William Thomson's previous estimate of the least value of the same distances, is 0·05 millionths of a millimetre. So that the true value probably lies between these two estimates.

CUTTING CAOUTCHOUC.—If the cutting tool, knife, or borer, be slaked in a solution of caustic soda of medium concentration, india-rubber can be cut into corks or other articles without difficulty.

ARCTIC IRON.—The large masses of native iron discovered by M. Nordenskjold, in Greenland, have been analysed by Mr. Lawrence Smith, who considers them to be of terrestrial origin, and to have been formed by the partial reduction of basaltic rocks under the influence of the carbonaceous matter so abundant in northern regions. On the other hand, M. Meunier thinks them to be detached fragments of a vast store of iron at the earth's centre. If this hypothesis of M. Meunier be true, the great problem of the terrestrial magnetism could be explained on the supposition of the internal mass being largely made up of loadstone.

AN ADDITION PENCIL.—A calculating pencil, capable of mechanically adding numbers ranging from unity up to 1,000 has recently been devised and patented in Germany. From the point or fore-end of the pencil a flat bar projects, which is graduated from 0 up to 9. When this is pushed inwards it presses against a coiled spring and actuates a rack at the other end of the pencil case so as to make it gear with one of three small pinions or wheels mounted in a row, and each having ten teeth. Each pinion has a cylinder connected with it, which can exhibit figures outside the case from 1 to 10. To explain how the pencil is used let us suppose we wish to add 5 and 8 together. We first push in the flat bar at the point as far as the number 5 upon it. This causes the first wheel to turn round and present the figure 5 on its cylinder. The flat bar is then forced out again by means of the spiral spring, but the first wheel is prevented from moving therewith by the action of a retarding spring. We next push in the bar to the figure 8 marked on it, an act which forces the first wheel round 8 teeth more. As it has now been turned round 13 teeth, that is, one complete revolution of 10 teeth and 3 over, the wheel presents the figure 3. But it is arranged that every complete revolution of the first wheel will advance the the second wheel one tooth, hence the latter presents the figure 1. The 1 and 3 thus indicated by these pinions make up the 13 of the required answer.

STRAW TIMBER.—The Americans are beginning to feel the strain on their lumber forests at last, and with ready ingenuity a substitute for building wood has been fabricated by an Illinois inventor. It consists of sheets of straw-board made up to the required thickness of board or plank, then steeped in a chemical solution which softens and preserves the fibre. The material is then rolled, dried, and hardened, after which it is impervious to wet and takes on any timber-dye or polish that may be fancied.

THE PSEUDOPHONE is the name given by Dr. Sylvanus P. Thompson to an instrument devised by him for exhibiting acoustical illusions, and for investigating some of the phenomena connected with binaural undition. It is for the ear, in fact, what the pseudoscope of Wheatstone is for the eye. It consists of two ear-pieces fitted with small tin reflectors of sound, which can be set at any angle with respect to either ear, and as these catch and reflect external sounds into the ear they are next to, it is possible to cause the greatest confusion in the hearing of a person, and to prevent him utterly from telling the direction in which a sound is coming.

City Notes.

Old Broad Street, Oct. 13th, 1879.

DIRECT SPANISH TELEGRAPH COMPANY, LIMITED.—The twelfth ordinary general meeting of the shareholders in this Company was held on the 30th September, at the offices, 106, Cannon-street, under the presidency of Mr. Neil Bannatyne. Mr. Charles Gerhardi, the manager, read the notice convening the meeting, and the report, an abstract of which has appeared in THE TELGRAPHIC JOURNAL, was taken as read. The Chairman said: If the shareholders looked at each account they would, no doubt, observe that the receipts for the half-year were about £545 in excess of those for the corresponding half of 1878, while the working expenses showed an increase of about £220. The increase in the working expenses was exceptional. It was caused partly by exceptionally extensive repairs to the Company's underground lines in Spain and France during the six months, and to their contribution (£100) to the Telegraph Conference. That item would not occur again—at least for some years to come. These two items, indeed, accounted for the whole in-

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crease in their working expenses, so, but for these exceptional items, they would have earned £545 increase of revenue without any increase of working expenses. He trusted that they might for the future, or for some years at least, have no exceptional items, and that they would be able to keep their working expenses under £2,000 for the half-year, which was always looked on as about the normal sum. The electrical condition of both cables, from reports received that day, continued as perfect as ever, and that had been the uniform report of the electrical engineer since their last meeting. Their cables had all along maintained the first-rate condition at which they had been for a long time past. As regarded the present half year, they would observe by the report what the directors recommended—that was, to place £500 to the credit of the reserve fund, which would then amount to £2,200, and to carry forward the small balance of £24 to next half-year. In reality, as they would see, the company were now in a better position than they had been for some years. They had their reserve fund at £2,200, they had no arrears of preference dividend, and the next thing they hoped to accomplish would be not only to pay their preference dividend and put something further to the reserve fund, but also to pay something on the ordinary shares. That led him to refer to the current half-year, on which they had now entered. Their receipts for the first two months showed an increase for that period of £218. Of course the month of September had not been completed, but they had twenty-nine days' receipts, and, as far as they could anticipate, they would be nearly the same as for the corresponding month of last year—about £1,000, a little under or over. If October, November, and December were only equal, supposing they had no increase on what they received in those months of last year, and that nothing occurred to the cables, they would be able to pay the 10 per cent. preference dividend, to pay a small dividend on the ordinary shares, and to put a further sum to the credit of the reserve fund. They had no reason to anticipate any interruption to the cables, and he thought they had every reason to anticipate that their returns for October, November, and December would be as good as they were last year. He thought it probable that they would have some increase of business from the marriage of King Alfonso, should it take place next month. With regard to the International Telegraph Conference, it was held in London, and had in view the remodelling of the tariff and system of charges. It was thought desirable that the company should be represented—indeed, it was necessary that it should be, and the result showed the importance of their being present at the deliberations. The Conference, as they were aware, had adopted a word-rate for European messages instead of a minimum of 20 words, as adopted at the present moment. To this they had had to give their consent. It was difficult to know how this new system, which would come into operation on the 1st of April next, would affect their traffic, but it was thought likely to affect it beneficially, so far as they could form an opinion. It would be rather an inducement to the class of persons who were now in the habit of using the Company's lines to telegraph to Spain, and would, it was thought, induce a new class of persons who had only short telegrams to forward, but who did not now use the lines in consequence principally of a few words being charged the same as 20 words. The average length of a message being about 15 words when the minimum was not enforced, the rate per word they had succeeded in obtaining from the Conference fully provided for this right—in other words, they would get from the 1st of April for 15 words as much as they now got for 20 words. He would be happy to answer any question." He concluded by moving the adoption of the report and accounts. Mr. Abraham Scott, a director, formally seconded the motion, which was carried unanimously without discussion. The Chairman then declared the dividend for the half-year on the 10 per cent. preference shares payable, less income-tax, on the 1st October. He added that the dividend warrants would be posted that night. Mr. Scott seconded the motion, and it was carried unanimously. The Chairman said he might have stated in his opening remarks that any little improvement they had gained during the half-year had been in spite of the continued depression of trade which prevailed in Spain as elsewhere. No doubt, with a general revival of trade, they would be greatly benefited. Mr. Archibald McNicoll then moved, and Mr. M. S. Gilmore seconded, a vote of thanks to the chairman and directors. The Chairman, in reply, said the Board would do their best for the interests of the shareholders. The proceedings then terminated.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY, LIMITED.—At a meeting of the directors held on October 1st it was decided to place £5,000 to reserve, and to recommend to the shareholders at the approaching meeting that a dividend at the rate of 6 per cent. per annum be declared on the 1st and 2nd preference shares for six months, ending the 30th June last, carrying £1,631 16s. forward to the current half-year.

REUTER'S TELEGRAM COMPANY.—The directors have declared an interim dividend at the rate of 5 per cent. per annum, free of income-tax, for the half-year ending June 30th last.

THE EASTERN EXTENSION TELEGRAPH COMPANY, LIMITED.—From the report of this Company it appears that the net profit for the half-year was £84,597, from which two quarterly interim dividends of 1½ per cent. each, amounting to £49,937, have been paid, leaving £34,660 to be carried forward. Resolutions will be submitted at the meeting of shareholders authorising the directors to acquire a concession from the Spanish Governement for connecting Manila by cable with Hong Kong.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58-59; Ditto, Preferred, 84-85; Ditto, Deferred, 34-35; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 7⅛-8; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 1⅞-2⅛; Direct Spanish, 10 per cent. Preference, 11⅛-11⅜; Direct United States Cable, Limited, 1877, 11⅛-11⅜; Eastern, Limited, 7⅛-8⅛; Eastern, 6 per cent. Debentures repayable October, 1883, 104-108; Eastern 5 per cent. Debentures repayable August, 1878, 102-104; Eastern, 6 per cent. Preference, 11⅛-12⅛; Eastern Extension, Australasian and China, Limited, 8-8¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, ½-1½ pm; Ditto, registered, repayable 1900, par 2 pm; German Union Telegraph and Trust, 7-7⅛; Globe Telegraph and Trust, Limited, 5⅛-5⅜; Globe, 6 per cent. Preference, 11¼-11½; Great Northern, 8⅜-8⅝; Indo-European, Limited, 21-23; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9¾; Reuter's, Limited, 9-10; Submarine, 225-230; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1⅛; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference 7⅜-7⅝; Ditto, ditto, Second Preference, 6¾-7¼; Western and Brazilian, Limited, 3⅛-3⅜; Ditto, 6 per cent. Debentures "A," 96-100, Ditto, ditto, ditto, "B," 91-96; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 31¾-32¼; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2⅜-2⅝; India Rubber Co., 12¼-12¾; Ditto, 6 per cent. Debenture, 103-106.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 162.

THE INFRINGEMENT OF PATENT RIGHTS.

SEVERAL of those unfortunate patent right litigations which every now and again mar the progress of invention are now impending in the electrical world. The most interesting of these is probably the long-mooted struggle between the Western Union Telegraph Company, owning the Edison and Elisha Gray telephone patents, and the Bell Telephone Company, owning the patent rights of Alexander Graham Bell. According to our contemporary, the *Iron Age*, "nearly a hundred patents embodying supposed improvements in telephones have been issued, and more than a dozen interference suits are now pending before the Patent Office, brought in the names of as many patentees. The general public knows only of the business rivalry between the Bell Telephone Company on the one hand, and the Western Union Company, owning the Edison patents, on the other; but before the courts and the Patent Office the controversy takes a character entirely different. The merits of the case are very difficult to reach, and seem not to be understood even by experts in electricity or patent law. So many fine points in electrical science and in patent law—the most evasive and crooked of all branches of jurisprudence—enter into the matter that one becomes involved from the outset in a labyrinth of technicalities so dense that a just and intelligible solution seems to be an impossibility. The interference cases are set for a hearing some time next February, and the time meanwhile is being taken advantage of by the counsel to take testimony bearing upon the cases. Stripped of side issues, the immediate controversy appears to be narrowed down to the question of priority in the application of the principle of the undulatory current to the transmission of spoken words." The *Iron Age* further states that Gray's July, 1875, patent, re-issued on January 28, 1879, forms the foundation of the counter claim of the Western Union against the Bell Telephone Company, which reposes its rights on Professor Bell's patent filed on February 14, 1876.

We also understand that the Edison Telephone Company of London, which, by the way, is an English company, intends proceeding against the Bell Telephone Company for employing Blake's microphone transmitter, illustrated in a recent number of the TELEGRAPHIC JOURNAL (Oct. 1st).

Another very important case on the cards is that brought by Mr. J. B. Stearns against Mr. John Muirhead for alleged infringement of his duplex patents. Every electrician knows that the first practical successes in applying the duplex system of telegraphy on submarine cables were achieved by Muirhead's inventions, after Stearns' system had been tried and found wanting, just as the first practical transmission of speech was achieved by Bell's telephone, while Gray's telephone was yet inadequate; but both of the defeated American inventors maintain that their "thunder has been stolen."

The main cause of these ruinous litigations attending so many great inventions, is not so much a love of right and justice as a greedy lust for money. When an invention proves to be successful and the rewards of success flow in, there are always plenty hungering after a share of the spoil, and ready to put forward their claims. Now, it is almost impossible to find an invention which is wholly original; one man's ideas suggest those of another man; one man improves on the work of his predecessor; and it often happens that the improvement in question makes all the difference between success and failure. Each advance is, however, a distinct invention, and the whole question comes to be whether it is so notable as to be regarded as original and valid *in patent law*. A sound knowledge of the technicalities of the subject in dispute and of the law of patents is, therefore, necessary to decide whether or not there is a true infringement of patent rights.

Going to law is, in our opinion, a deplorable method of settling such disputes. Judge, counsel, and jury, are too often ignorant of any branch of science and utterly incompetent to decide the point at issue; and the result is that fortunes are squandered to fill the pockets of legal sharks, personal feelings are embittered beyond expression, and the dignity of invention is disgraced by mean motives and low suspicions, without any just decision being arrived at after all.

It is not an agreeable sight to see inventors publicly wrangling over the products of their genius, and preying upon each other like so many Kilkenny cats. By far the better plan would be to endeavour to come to some private arrangement whereby an amicable and just compromise could be effected. If one inventor's plans have been simply improved, however markedly, by another inventor, and there is a real and true evidence of generic relationship between them, then the prior inventor, even though his work is unsuccessful, is entitled to recognition,

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for his invention was the germ of the more feasible one, and some portion of the profits may well be accorded him. On the other hand, if there is a specific distinction between two inventions, even although one of these may have *suggested* the other, there can be no legitimate claims between them. To further a peaceful mode of settlement, the question should be submitted to an expert in the patent law and the technical subject in hand for his adjudication. This plan may, of course, be objected to on the score of biassed judgment, bribery, &c., but with proper care these are evils which can be minimised, and, at least, they are of far smaller importance than the evils of trial in court. The recent decision of Sir William Thomson, on the improved process for the dephosphorisation of iron, is a case in point; and we think it would be well if these outstanding electrical disputes were to be settled in a similar way. Arbitration, and not trial at law, is the proper process.

NEW RESEARCHES ON THE THEORY OF THE MICROPHONE.

By DR. JULIAN OCHOSWICZ.

Two distinct hypotheses have been put forward to explain the phenomena which occur in the ingenious discovery of Mr. Hughes. The one, exclusively molecular, supposes dilatations and contractions of the molecules in certain partially conducting bodies, to take place under the influence of sonorous vibrations, in the microphone itself. *Changes of density* correspond to the increase or decrease of the resistance of the circuit, and, consequently, to a proportional production of sounds. This hypothesis bears a certain analogy to the phenomena which take place in selenium under the influence of light and radiant heat.

The other, partly molecular and partly mechanical, rests upon the discovery, made some time ago, by M. du Moncel, and according to which the increase and decrease of resistance are due to changes of pressure in the electrical points of contact. These changes being produced by the pressure of the vibrating air, there results an equivalence of causes and effects.

In basing my theories on experiments made with a very great number of microphones, since the first appearance of this discovery, I shall endeavour to prove that, if one of these hypotheses is entirely erroneous, the other is only superficially true.

In the first place:

1. When the carbon rod is immovably fixed by any cement, wax for example, without submitting it to any pressure, the microphone remains inert under the most powerful sonorous effects. This would be impossible if it acted by molecular action only and not mechanical.

2. The microphone can be placed in a tube of glass, lightly suspended by means of a fine wire, and the air exhausted in the tube without affecting its microphonic effects. It is evident that, in this case, the waves of air can have no influence upon the density of the carbon, they only act mechanically by shaking the whole apparatus.

3. It is impossible to construct a microphone of a single piece of solid carbon, presenting firm contacts, which do not prevent molecular influences, but which render impossible the action of sonorous waves, of contacts, and of shakes, on the current which traverses the carbon.

It appears to me, then, that we have these sufficient reasons for entirely rejecting the exclusive molecular theory.

Again:

1. The lateral pressure exercised on a compact electric conductor (metal, carbon, &c.) placed in a telephone, does not produce any microphonic action.

2. A longitudinal pressure exercised on the rod of a microphone by means of a thumb-screw, can modify within certain limits without altering the action of the apparatus. This is only the *timbre* which alters the intonation. But the same effect can be obtained without change of pressure, by the simple fact of changing the points of contact. If the pressure is augmented, the apparatus loses its sensibility at the same time that it loses its faculty of vibrating mechanically; but the single fact of an augmentation of pressure has no connection with any microphonic phenomenon. This experiment relates to a microphone with a membrane.

3. Apparatus can be constructed in which the pressure remains the same, and which nevertheless acts as a microphone. (See figure.) It is hardly rational therefore to consider pressure as the essential cause of microphonic phenomena.

It is, however, an accidental cause, for when the sonorous waves strike the movable part of the apparatus, the pressure which it exercises on the support changes; but this is not from the fact of the pressure causing the differences of resistance; it is from another fact, often parallel to the first, but which differs from it.

In order to understand this better, let us consider the apparatus in its simplest form, as shown by fig. 1.

FIG. 1.

Two short pieces of wire, in circuit with the microphone and telephone, are stretched across one another as shown; the current passes at the point of crossing. It is *at this point only* that the microphonic action takes place. When one of the wires is caused to vibrate from any cause, a noise or very strong musical sound fills the room in which the telephone

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is placed. If the wires are good conductors the action of the apparatus has two phases: the current passes when one wire touches the other, it does not pass when the reverse is the case. There is then a *simple and complete interruption of the current*, and, in consequence, this microphone, like the transmitter of Reiss, like the singer of Mr. Pollard, &c., can only transmit simple sounds. This first category embraces all the microphones in which the contact is effected at a single point. I have obtained better results of the kind with a bladder membrane and sharp point. The electric communication was ensured by a little strip of tinfoil glued on the membrane. With a small bichromate battery the tune could be heard all over a room. Strictly speaking, there is in these simple apparatus certain graduations of action between the limits of full intensity and of complete rupture of the current, and one can understand that sometimes the *interruption is only partial. It is then the alteration of the points of contact* which plays here the principal *rôle*. *The intensity* of the sounds depends upon the greater or less number of these points; the number of successive interruptions of the same contacts determines their *pitch*, and the nature of the changes their *quality*. In fact, the successive and simultaneous combinations, periodic or non-periodic, of all these changes determine their *articulation*. It is sufficient to compare the traces of the words in the phonautograph, the logograph, and the phonograph to convince oneself that it is, in these apparatus, only a reduction of *quality* to quantity. I am even inclined to believe that this reduction is very simple, and that a series of combinations in times and in spaces of *three material points of contact* is sufficient to produce an equivalent to all our articulate sounds. It would be difficult to relate all the experiments and inferences which have led me to this supposition, but I give them for what they are worth, and now pass to the third category.

The principle of the change in the number of points of contact caused by pressure allows us to consider the different resistances of the microphonic circuit, and explains the action of the majority of microphones, but it does not explain all.

It is possible to construct, in fact, microphones in which no alteration of pressure will produce a variation in the numbers of points of contact, but which, nevertheless, work well.

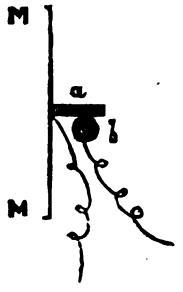

FIG. 2.

Suppose a little cylinder of carbon, *a* (fig. 2). fixed horizontally to a membrane, M M, and sliding on another small cylinder of carbon, *b*, movable about its axis. If the cylindrical form of these two pieces is perfect the pressure and the number of points of contact remain the same. If this is not so, as would practically be the case, then the *rôle* played is different; it is *the* length of the route traversed by the current in the bad conductor. Whilst the membrane vibrates, its distance from the carbon *b* diminishes or increases, and there is then a change in the number of the points of resistance crossed.

It is this class of apparatus to which belong the liquid telephone transmitters of Gray, Bell, and Palet, where the change of resistance in the circuit results from a layer of liquid more or less thick, which is to be traversed by the current.

It is very difficult to separate the two principles one from the other, but it is possible to determine the preponderance of the one or the other, or still better their parallelism. Suppose, for example, that the two cylinders of carbon, *a* and *b*, were replaced by two plates of the same material, and that *b* remains immovable, the two actions would be equal and opposite. The same complication presents itself in the microphonic transmitter of M. Righi, where the metallic disc of the membrane plunges in the powder of plumbago mixed with powdered silver.—*La Lumière Electrique.*

ARBORESCENT ELECTRIC DISCHARGES.

IN former numbers of the TELEGRAPHIC JOURNAL we have illustrated the interesting experiments of M. Gaston Planté on the form of the sparks obtained from his rheostatic machine of 80 condensers under various conditions. More of these have recently been published by him in the second part of his work on *Recherches sur L'Electricité*,* and we are now enabled by his courtesy to place before our readers the most novel of them.

ARBORESCENCES.—When the poles of the machine are laid on a plate of insulating matter sprinkled with powder of sulphur the sparks are much elongated, and they also present tree-like figures when the excess of sulphur is raised by slight shocks given to the plate. Fig. 1 shows one of these figures, full size, obtained from a spark 0·15 metres long.

These effects explain the patterns of vegetation sometimes seen on persons struck by lightning; they are merely the branching of the lightning track.

Fig. 2 represents the furrow produced in the sulphur by a spark before giving the shocks which cause the arborescences. It will be observed that the width of the furrow is greater on the side of the positive pole. On the rays round the positive pole the sulphur is heaped up, while the traces round the negative pole correspond to the negative features seen in fig. 1.

* Published by A. Fourneau, 18, Rue de la Sorbonne, Paris.

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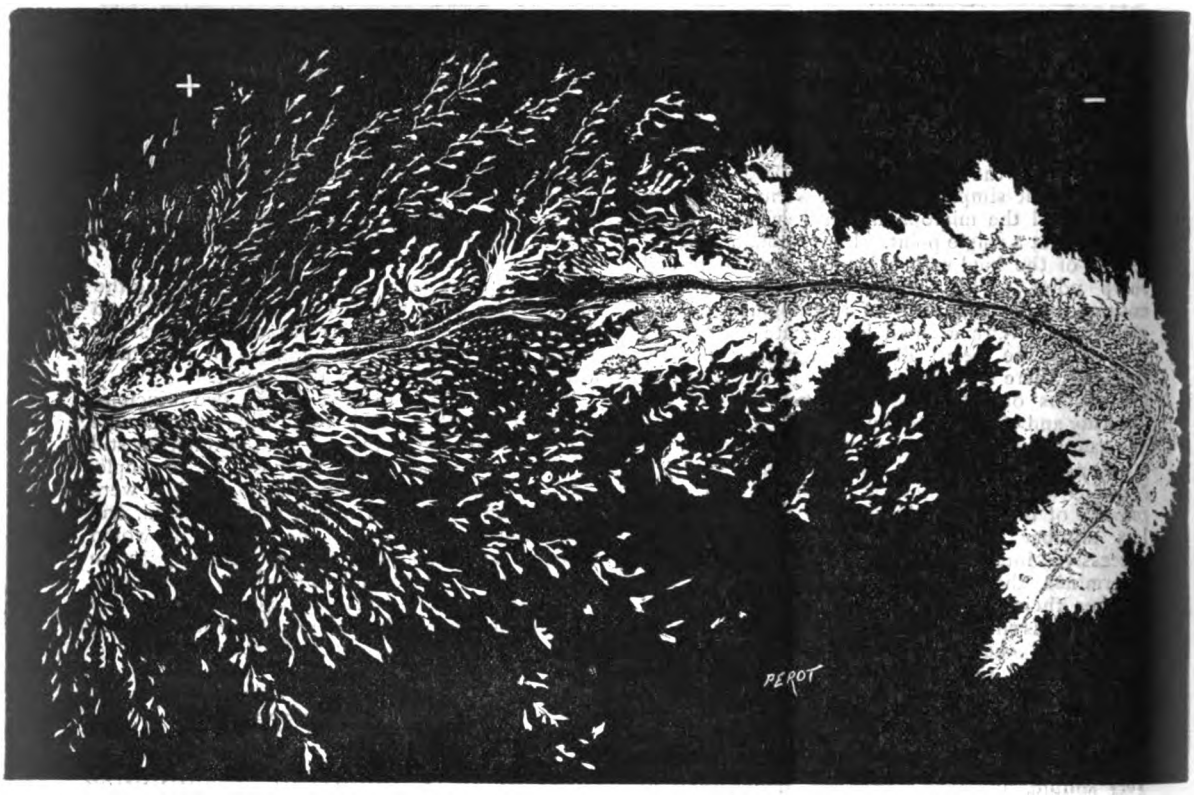

FIG. 1.

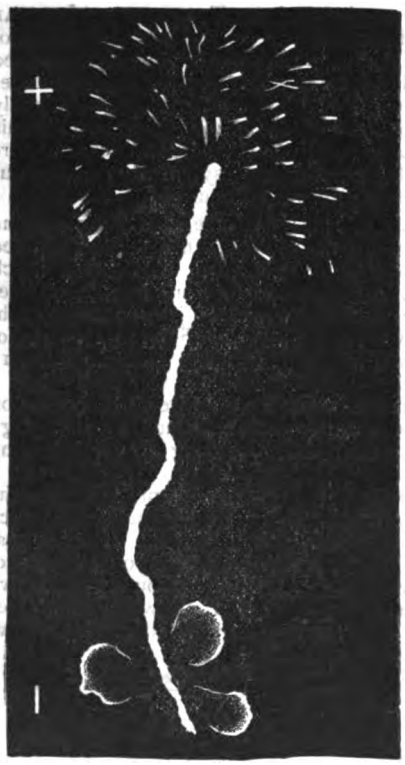

FIG. 2.

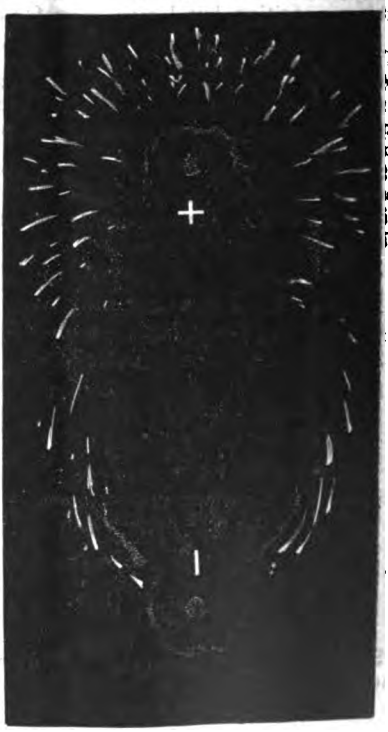

FIG. 5.

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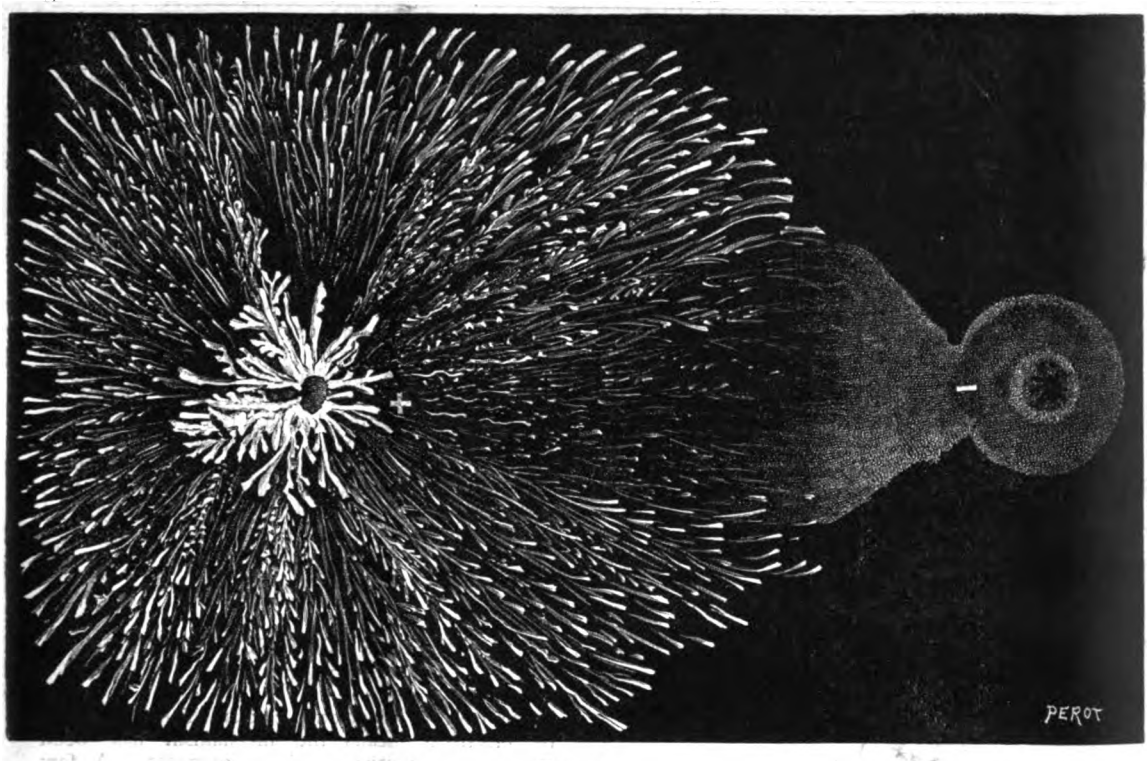

FIG. 3.

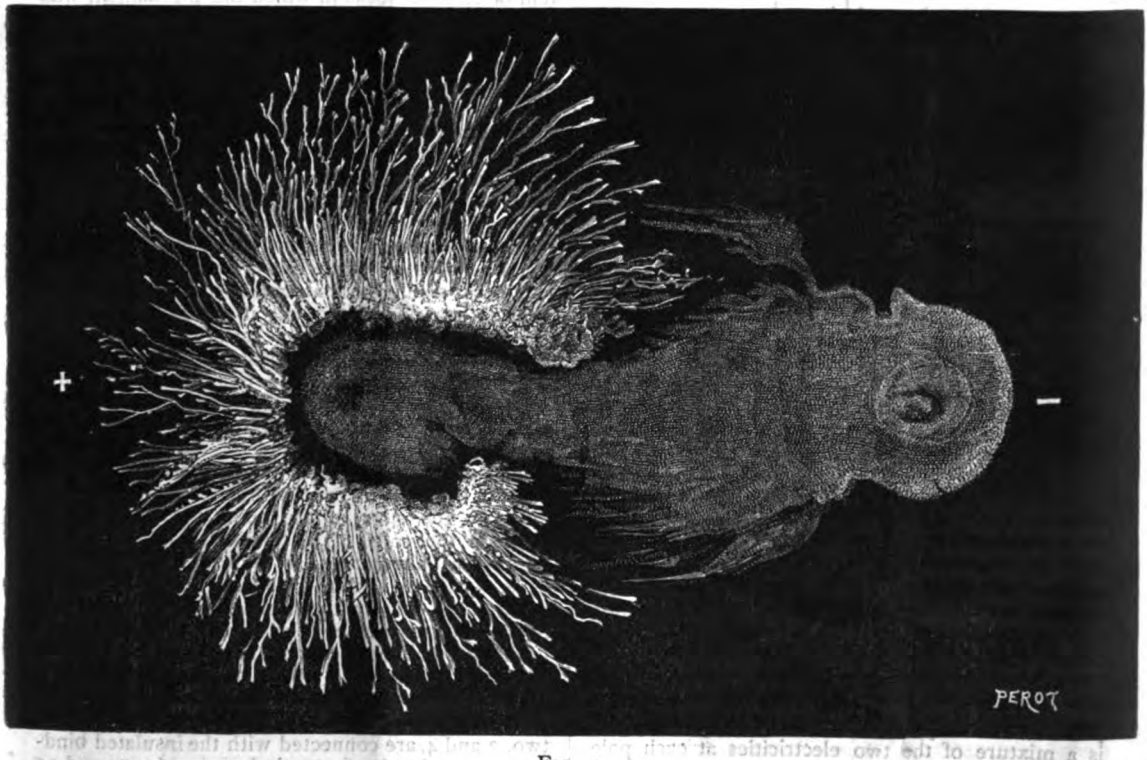

FIG. 4.

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LICHTENBERG'S FIGURES.—On a surface of pure resin shed with powder of sulphur and red lead the sparks give beautiful Lichtenberg figures of a different kind, which when fixed on gummed paper constitute valuable aids to the study of the electric discharge. These are illustrated by figs. 3 and 4.

The difference between the effect produced by the brush discharge and sparks is very marked.

When the distance between the points of the excitor is too great for the spark to pass, and a brush discharge only appears, the electric movement of the ponderable matter leaving the negative pole, manifested by the red lead which adheres to the resin, does not extend to the positive pole. This last pole only presents traces of red dust in the middle of the crown of sulphur, with diverging rays, which surrounds it (fig. 3).

But if the spark has passed, this crown is open and the interior is filled with red-lead powder, showing that the electric movement leaving the negative pole extends even to the positive pole (fig. 4).

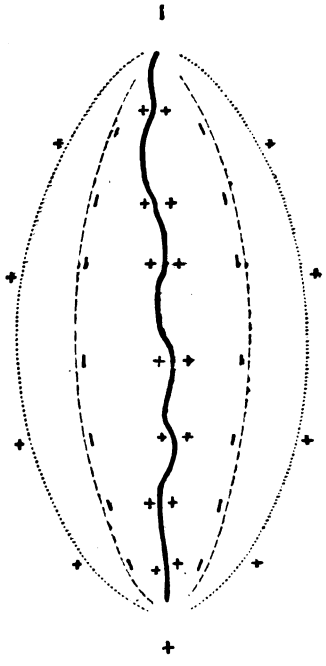

FIG. 6

In the case of the spark the distribution of negative electricity presents a curious crab-shaped appearance (owl-shaped would, we think, be a better term); in the case of the brush it resembles more or less the form of a polype having its tentacles directed towards the positive pole without attaining to it.

On the other hand, when the spark passes one recognises sometimes, by the traces of sulphur round the negative pole, that the emission of positive electricity extends itself to that pole. There is a mixture of the two electricities at each pole (fig. 5).

This observation explains how in the circuit currents of very high tension, which approach closely to a series of continuous static discharges, can produce complete decomposition of water at each pole, and consequently a mixture of oxygen and hydrogen.

One remarks also that the movement leaving the positive pole envelops externally, like a sheaf of rockets, the negative movement (figs. 3, 4, 5).

Often one perceives at the same time an interior flow of positive electricity round the line of the spark, besides the positive exterior enveloping current, and between the two the negative electric current, which seems as if sucked up (*aspirée*) by the positive current (fig. 6). The negative electricity of the ponderable matter which she takes along moves in an annular space formed by the electrified matter leaving the positive pole. This observation explains the effects of suction or ascension of water that we have obtained with currents of high tension. Do we not also in this phenomenon find the explanation of the uprise of water in the cloudy interior of a waterspout?

SHEPHERD'S ELECTRO-MAGNETIC CLOCK.

IN the majority of electric clocks which are *driven* by electrical means the mechanism has been actuated by means of electro-magnets. A few years ago Sir Charles Wheatstone invented a system of electric clocks in which the mechanism was driven by means of a magnetic needle or needles, which revolved continuously within an ordinary galvanometer coil, the driving power being an electro-magnetic current induced by the movement of a pendulum driven by a weight. This system failed, after repeated trials, in consequence of the magnetic current produced being insufficient to overcome the inevitable irregularities which tend to cause a clock to stop if sufficient margin of power is not allowed to overcome them. Mr. Charles Shepherd has recently devised a system of electric clocks in which the driving mechanism is somewhat similar to that employed in the clocks of Wheatstone referred to, but in which the driving power is a current from a battery. The battery not only drives the clock mechanism but also keeps the regulating pendulum in motion. The means by which this latter is effected are shown by figs. 1 and 2. In this arrangement 16, 17, 18, are three bar magnets; 19, 20, 21, and 22 are four coils of insulated wire. The three magnets are fixed on an arbor 23, so as to revolve freely, the upper and lower in the slots of the coils, the middle one between the coils. The magnets are fixed with their poles alternating, as shown by the letters N, S, N, so that when electric currents are sent through the coils in the same direction the action on all three magnets will be to turn or deflect them in the same direction; 1, 2, and 12 and 13 are four contact springs tipped with platinum; 3, 4, 14, and 15 are four pieces of platinum attached to but insulated from the pendulum by pieces of ivory; the two, 3 and 4, are connected with the insulated binding screw 7 by the fine spiral spring 6; 14 and 15.

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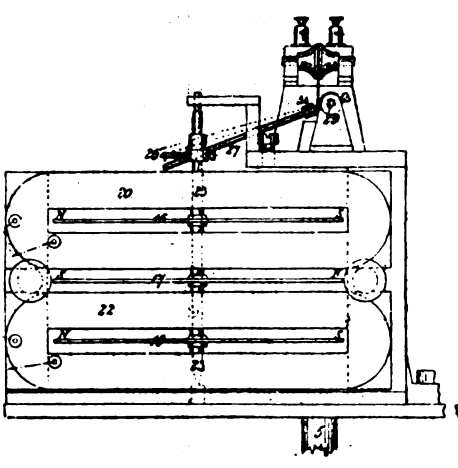

FIG. 1

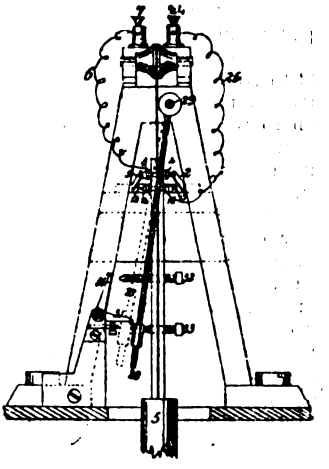

FIG. 2

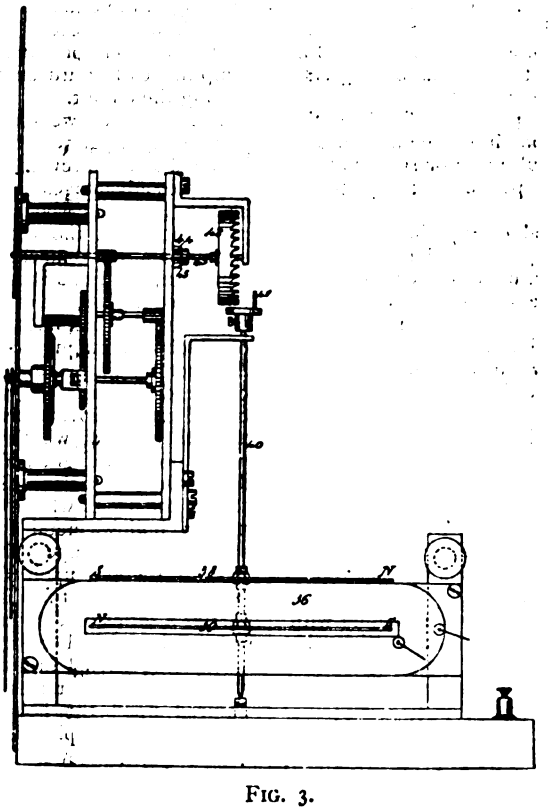

FIG. 3.

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are connected with the binding screw 24 by the fine spiral spring 25.

As the pendulum swings it alternately makes and breaks contact between the pieces of platinum attached to the pendulum and the contact springs, which being connected with galvanic batteries, cause electric currents to pass through the coils 20 and 22; if the magnets are now started, revolving in the reverse direction to which the hands of a watch turn, they become perfectly under the control of the pendulum, making one revolution for each double vibration.

The arbor 23, on which the revolving magnets are fixed, carries a collet with a pin 26 fixed in it, which as it revolves acts against a rod 27, lifting it into the position shown by dotted lines in fig. 1, at the same time moving a rod 28 which is fixed to the same arbor (29), and thereby causing a part projecting from the rod to pass and become held by the hooked end of a detent 31 (see fig. 2).

As the pendulum returns to the left the pointed screw 32 acting on the arm $31^{\times}$ of the detent lifts the detent and liberates the arm or rod 28, which aided by the gravity of a weight 34 on the arm or rod 27 (attached to the same arbor as 28) presses against the screw 33, and in the return vibration of the pendulum to the right follows it and gives the necessary impulse to keep the pendulum in motion.

The pendulum having completed its swing to the right, the magnets will have made an entire revolution and the pin 26 will again come in contact with the lever 27, and lifting it will once more lock or engage the projection of the impulse rod 28 in the detent 31, in readiness to be released for giving another impulse to the pendulum 5.

The collet carrying the pin 26 is fixed on the arbor 23 by a screw, so that it can be moved and adjusted to move the impulse arm or rod 27 at the desired moment when the pendulum completes its swing to the right.

Fig. 3 shows the method of applying the rotary magnets to driving sympathetic clocks. These, when of ordinary size, say, up to dials two feet in diameter, will not require much power to keep them going; two coils, as represented in the figs., will be found sufficient; but for larger dials with the hands exposed to the wind, eight or more coils of larger size might be required, the size of coil, weight of the magnets, and thickness of wire, all being increased in proportion to double the dimensions, so as to give the required power. 36 and 37 are two coils of wire; 38 and 39 are bar magnets; 40 is the arbor carrying the magnets, so that they may revolve freely, one in the slot of the coils and the other above the coils. The magnets are fixed with their poles in opposite directions, as represented by the letters N.S.N.S.

It is found best to have the coils wound with about 1,500 yards of No. 35 wire, and to make the magnets (for the clocks shown) about $4\frac{1}{2}$ inches long, $1\frac{1}{4}$ inches wide, and $\frac{1}{10}$th of an inch thick, and of a weight of about 500 grains.

The arbor 40 carries at its upper end a collet with a pin 41 fixed in it, which is so adjusted as to take into the teeth of the escape-wheel 42, having thirty teeth moving it forward, one tooth or two seconds for each revolution of the magnets; the arbor 43 of the escape-wheel is held by two springs 44, 45, which are made to press with such force as to prevent the wheel from moving except when acted upon by the pin 41.

The train of clockwork represented as being thus driven is an ordinary arrangement minus springs or weights.

It will be evident other arrangements of clockwork may be actuated on the plan, and that instead of the escape-wheel with thirty teeth, a wheel of sixty teeth may be used in conjunction with two pins in the collet so as to cause the hand to indicate seconds. Or the arbor may carry a pinion in gear with a toothed wheel on the arbor 43 or its equivalent.

THE MORI-GRIFFIN LAMP.

THE advantages claimed for this lamp, which is the invention of Messrs. Mori and Griffin of Leeds, are its automatic action and arrangement of parts, and the doing away with personal attention except at long intervals, say 9, 12, or 18 hours, according to the number of candles or carbons the lamp is constructed to hold.

A great saving in wire is effected by the automatic commutator or switch being made a part of the lamp. It is possible by its means to switch off and re-light at will any one or more of the lamps in circuit, without any perceptible change in the burning of the other lamps in the same circuit.

No injury can occur to the lamp after the whole of the carbons or candles are consumed, as the lamp moves forward on to a contact, thereby completing the circuit.

In figs. 1 and 2 we have illustrated a lamp for consuming eight pairs of carbons. This lamp is constructed so as to revolve upon a central spindle, and possesses advantages over the foregoing, inasmuch as the lighted carbons always occupy the same position, whilst the construction of the lamp is simpler and more mechanical. Fig. 1 is a sectional elevation, and fig. 2 is a plan view. A is a disc of hard wood, glass, or other suitable substance, and B is a circular box fixed underneath, in the middle of which is a binding screw *a* and a fixed spindle *b*. Another binding screw C is fixed to the under side of the disc, connected with which is one end of a coil of insulated wire forming the electro-magnet D, the other end of which wire is fixed to the stud *c*, which projects slightly above the upper face of the disc. On the surface of the disc is also a metal stop *d*, the use of which will be hereafter explained. E is a hollow metal tube, which fits upon the spindle *b* resting upon the bottom of the box, and free to revolve upon the said spindle. At the upper end of the tube is a circular table F, which carries a series of carbons, numbered 1 to 8, which are the inner carbons of each pair, the outer carbons being carried in holders G hinged to brackets H, screwed to the under side of a circular plate J, secured upon the hollow tube E. Between the brackets and the plate is a thickness of vulcanite *e*, and over the screws which secure the brackets to the plate are bone insulating eyelets. To each bracket H is secured a contact-maker *h*, that belonging to number 2 pair of carbons being shown resting upon the stud *c*. On the upper side of the plate J are a series of flat curved springs *f*, secured

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by screws to the outer edge of the plate, and having pins *g* at their inner ends, which pass down through holes in the plate. When the springs are pressed down close to the surface of the plate, the pins on the end are lower than the stop-piece *d*, but when released the bend of the spring lifts the pin clear of

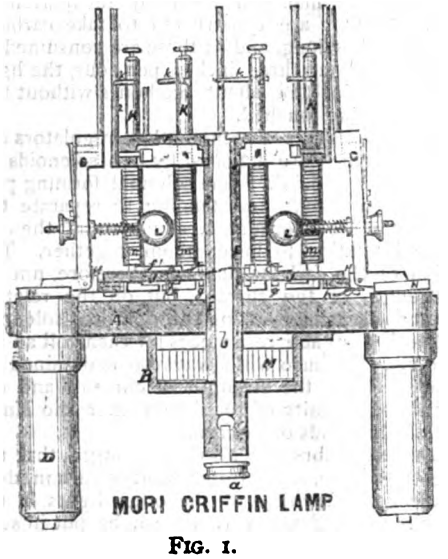

FIG. 1.

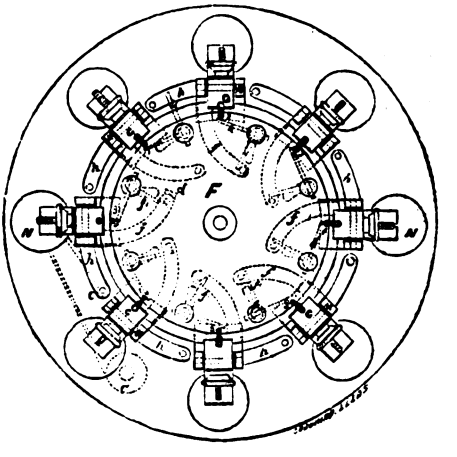

FIG. 2.

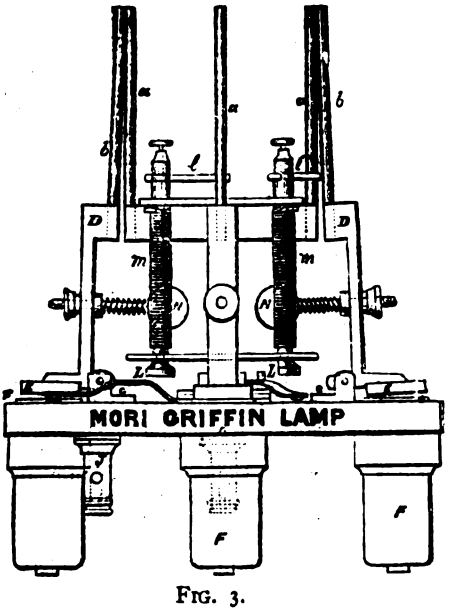

FIG. 3.

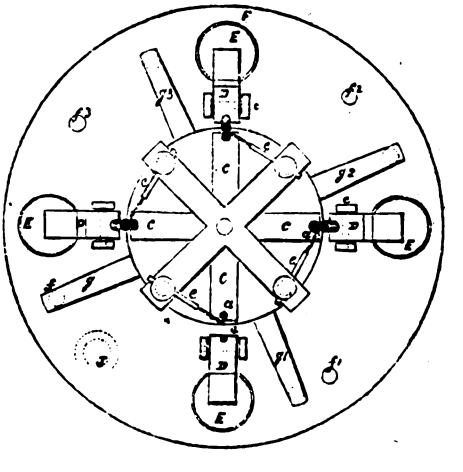

FIG. 4.

supply of carbons are inserted, and the lamp wound up by turning it round upon the spindle *b* until the spring M is in such a state of tension that it will when released carry the lamp round in the direction of the arrow; the rods K are then turned round, tightening the springs on the lower portion thereof,

the stop-piece. For pressing down the springs *f* we have a series of fingers f^1, inserted at right angles into upright rods K. L are adjustable weights for tilting the outer series of carbon holders, so as to bring the tips of the carbons together; in the circular box is a coiled spring M, which is hooked into the tube E. To set the lamp the requisite and causing the fingers f^1 to press down the springs *f*; and in this position they are retained by the fingers *k* which are placed so as to bear against the inner carbons; the lamp being then released it will turn round until one of the pins *g* comes in contact with the stop-piece *d*, at the same time one of the holders G will be opposite the magnet, and the con-

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tact-maker *h* will rest upon the stud *c*. The circuit is then complete between the two poles of the current represented by the two binding screws C and *a*. Supposing it to enter at the screw *c* it will pass through the magnet to the stud *c*, to the contact-maker *h*, and through the holder G to the outer carbon, thence through the inner carbon forming the luminous arc, and down the pillar E to the terminal *a*. The moment the current is established the magnet attracts the armature N, and places the outer carbon parallel to the inner one, towards which it had been inclined by the weight L, so as to facilitate the first flow of the current. When the carbons are consumed (as shown by pair number 1) as far as the finger *k*, the rod K is released, and the spring *m* turns it outward, removing the finger f^1 from its spring *f*, which rises and removes the pin *g* from contact with the stop-piece *d*; the spring M then causes the lamp to revolve until stopped by the next pin *g*, and so on for the whole series. As soon as the rod K turns a contact-maker *n* at the bottom thereof is caused to bear against the bracket H, and so makes the circuit complete, whilst diverting it from the carbons. It will be seen from the foregoing description that although the current is diverted from the carbons by the contact-maker *n* it still passes through the magnet, and continues to attract the armature, opposing the revolution of the lamp. To obviate this the current may be caused to pass from the screw C to a pin *q* which secures one end of a flat spring *r*, the other end of which is raised a short distance from the face of the plate A. A pin *s* attached to the free end of this spring passes through the plate A, and directly underneath it is a contact-maker which leads to the magnet. As the lamp revolves the part *n* presses upon the spring *r*, and presses the pin down upon the contact-maker, thus rendering the circuit complete; as soon as the carbons are consumed the part *n* leaves the spring *r*, which then rises and leaves the contact-maker, thus interrupting the current until the armature has left the magnet, and another taken its place. Figs. 3 and 4 show another form of this lamp for four pairs of carbons.

Secondly, their invention consists in the use of an apparatus constructed in a similar manner to the lamps above described for regulating the transmission of currents to different circuits. For this purpose a self-acting or spring commutator may be employed, and its operation controlled by a series of triggers released at the required time by the consumption of a pair of carbons, one pair of carbons releasing one or more triggers either simultaneously or at different intervals as may be required. Such an apparatus may be so arranged as to require personal attention at considerable intervals only, and may be made to perform operations which at present are only performed with less regularity by hand.

LIGHTING OF THE BRITISH MUSEUM BY ELECTRICITY.

THE lighting of the British Museum by the electric light has been commenced for the winter season, and with great success. Two different systems are employed, the Reading-room itself being lighted by four lights of 5,000 candle-power each, produced by continuous currents, and the seven 400 candle lights, which are distributed over the entrance halls and the outside of the Museum, being connected in one circuit of about 1,200 yards length to an alternate current machine.

The regulators in the Reading-room are the invention of Messrs. Siemens and Halske, of Berlin, and are of a very simple construction, so that they can be easily managed even by inexperienced hands. As they are constructed to take carbons nineteen inches long, and as these are consumed at the rate of about three inches per hour, the light can be maintained for about six hours without the regulators being touched.

For the alternate currents other regulators are employed, which are actuated by two solenoids on a differential principle; one solenoid forming part of the main circuit and tending to separate the carbons, the other forming a shunt round the carbons and tending to bring them together. The position of the carbons depends, therefore, not on the strength of the current, but on the relative amount of electricity passing through each solenoid. By choosing suitable resistances for each coil an arc of a given resistance will always be maintained independent from the strength of current, and obviating the necessity of regulation after the lamps have left the hands of the makers.

These regulators are also so arranged that the going out of one, say through want of carbon, does not affect the burning of the other lights in the same circuit; and new carbons can be put in such a lamp in about half-a-minute, when it is ready to burn for another five hours.

The machines which supply electricity for the lights are placed in a shed behind the Museum, and are six in number, five being of the ordinary Siemens type (TELEGRAPHIC JOURNAL, November 15th, 1877), size B, and the other a Siemens-Alteneck alternating current machine (TELEGRAPHIC JOURNAL, September 1st, 1879). One of the machines is employed as the inductor for exciting the inducing magnets of the five others. The machines are driven by two 8 horse-power (nominal) steam engines, supplied by Messrs. Wallis and Steevens, of Basingstoke. These engines, which run very uniformly, are worked up to an indicated horse-power of 22, the steam pressure being 60 lbs. and the revolution per minute 120. The cylinders are 9½ in. diameter and 13 in. stroke. Messrs. Wallis and Steevens have just patented a new arrangement, which will enable the governors to maintain any particular rate of speed that may be desired, the adjustment being made gradually and without stopping the engine, thus fulfilling the condition so much desired by electricians, viz., the power to increase or diminish the normal speed of the engine at pleasure according as the lights require it, and then to maintain with perfect regularity the particular speed which is found to give the best light. The cylinders are steam-jacketed on Messrs. W. & S.'s improved plan of making the jacket and liner separate and fitting the liner into the jacket. The boilers are tested by hydraulic pressure to 150 lbs. per square inch, viz., double the highest working pressure of 75 lbs. to the inch. The fire-grate area and the amount of heating surface are unusually large. The engines are fitted with the makers now well-known Patent Annular-space Feed Water Heater, which delivers the feed water into the boiler at a temperature of

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about 205 degrees, the special feature of this heater being that the exhaust steam is not mixed with the feed water; that the water is heated after passing through the pump, thereby getting rid of the difficulty of pumping very hot water; and that the whole of the heating surface over which the feed water passes can be exposed for cleaning in less than five minutes by the removal of two small covers.

The leading wires from the machines to the lights in the Reading-room are brought over the roof of the buildings to the lantern on the top of the dome, being a distance of about 200 yards, whereas the leads for the other lights are laid partly in the basement and partly in pipes underground.

EDISON'S ELECTRIC GENERATOR.

WHEN Mr. Edison said he was about to produce a practical economical electric light for general use, the entire business world took it for granted that it was forthcoming. Gas stocks tumbled both in this country and in Europe, and the people waited for the coming light. Scientists having had experience in this direction shook their heads, but for the most part suspended judgment.

Delay on the part of Mr. Edison comforted the holders of gas stocks, and confirmed the scientists in their belief that he had undertaken not only a task of great magnitude and difficulty, but one that would require more time and means than could be controlled by most experimenters. But Mr. Edison, flushed by his scientific victories, was undaunted and determined to yield to no obstacles.

Unfortunately, however, the daily papers from time to time printed reports of progress in electric lighting, which, from their extravagance and inaccuracy, placed Mr. Edison, to say the least, in an extremely embarrassing position as regards his alleged promises and the expected fulfilment of them, besides misleading the public as to the true nature of the problem to be dealt with, resulting in a reaction of feeling prejudicial to Mr. Edison's just fame.

At present little is said by Mr. Edison concerning his electric light, excepting that he considers it an assured success, and that he is perfecting the details of his electric lighting system as rapidly as possible.

It is not our purpose just now to enter into a description of Mr. Edison's electric lighting system as a whole, but to describe his new electric generator—one of the most important factors of the system—and also to describe his new electrical motor used in driving light machinery for domestic and industrial purposes.

The new generator resembles in some respects other well known forms, but it differs from them all in several very important particulars; for instance, the field-magnets are immense, being about 54 inches high, and weighing about 1,100 lbs. The magnet cores—of wrought iron—are 6 inches in diameter, and 36 inches long; they are mounted upon heavy cast iron blocks, 10¾ inches high and 9 inches wide, and are connected at the top by a wrought iron yoke, 6 inches high and 7 inches wide. The cores are wound with 3 layers of No. 10 cotton covered wire, the ends of which are connected with binding posts on the base of the machine. The two blocks upon which the cores rest, as well as the bearings of the armature, are supported by a cross-shaped brass casting.

The armature which revolves in the cylindrical space between the poles of the field-magnet is shown in section in Fig. 1. It consists of a wooden cylinder, A, mounted on a 1½-inch shaft, and having attached to its ends soft iron plates, B, between which there are several layers, D, of No. 20 soft iron wire wound circumferentially. Outside of the iron discs, B, there are vulcanised-fibre discs, C, having their peripheries notched to receive the several coils, E, of insulated wire wound lengthwise on the cylinder and connected with copper bars, F, of the commutator cylinder, G. There are 41 $\frac{42}{1000}$ inch wires in each strand, and each strand passes lengthwise around the cylinder on diametrically opposite sides, the opposite ends of all of the wires in each strand being soldered to commutator bars on opposite sides of the commutator cylinder. There are 40 strands surrounding the armature, and the commutator cylinder is pressed on opposite sides by copper wire brushes which take off the current. The armature shaft has a 10-inch pulley with a 5-inch face, and the speed of the machine is about 500 turns per minute. Although the current from the armature may be used to excite the field-magnet, Mr. Edison finds it more economical to charge the field-magnet by means of a separate machine. In fact, he intends to charge a battery of such generators with a single Faradic machine of this form.

An important fact has been developed in the course of Mr. Edison's experiments with this generator. He finds that by connecting the ends of the field-magnet by a copper wire for a moment when the machine is started, the field-magnet soon attains its maximum charge, which it retains so long as the generator is in continuous operation. It requires a minute or more to fully charge the immense magnets, and when charged their influence is far reaching and powerful. The internal resistance of the armature is only ½ ohm, and Mr. Edison claims that he realises 90 per cent. of the power applied to this machine in effective external current. It requires but 5 horse-power to drive it, and the current generated is sufficient to make 40 lights of 16 candles each. The economy of this machine is shown by the fact that one man may turn it with sufficient rapidity to maintain the electric arc of a Jablochkoff candle.

While this generator in general principle is the same as in the best of the well-known forms, still there is an all-important difference, which is, that it will convert and deliver for useful work nearly double the foot-pounds of energy that any other machine will under like conditions. It has been shown by Hopkinson that the Siemens machine, which is generally recognised as the best form yet devised, converts from the belt to the circuit 92 per cent. of the energy, but later corrections reduce this to 83 per cent.; from these results many scientists have inferred and stated that there was little margin for improvement in the generating machine. Now the energy converted is distributed over the whole resistance; hence if the resistance of the machine be represented by 1, and the exterior

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circuit by 9, then of the total energy converted, $\frac{9}{10}$ will be useful, as it is outside of the machine, and $\frac{1}{10}$ lost in the resistance of the machine.

The Siemens machine, and nearly all other machines in use, make the external resistance equal to that of the machine; hence one-half of the energy only is useful, and any attempt by these inventors to increase the exterior resistance, so as to change the distribution of energy to obtain more exterior work, results in reducing the power of the machine to convert energy. Therefore, efforts toward economy in one direction are met in the other direction by loss in the interest account due to the necessity of using a greater number of machines to convert a given amount of power.

meets squarely both ends of the question, and is carrying on his experiments on a gigantic scale; being encouraged by new developments he continues his researches in expectation of still better things. His electric generator he considers complete; his electric lamp, although in good usable form, is slowly improving, and will not be introduced to the public so long as Mr. Edison thinks it can be improved.

. . . . . .

Fig. 2 shows Mr. Edison's new electric motor intended for running sewing-machines, small elevators, lathes, and other light machinery, by connecting it with the same wires that furnish the current for the electric lamps. Its construction differs but

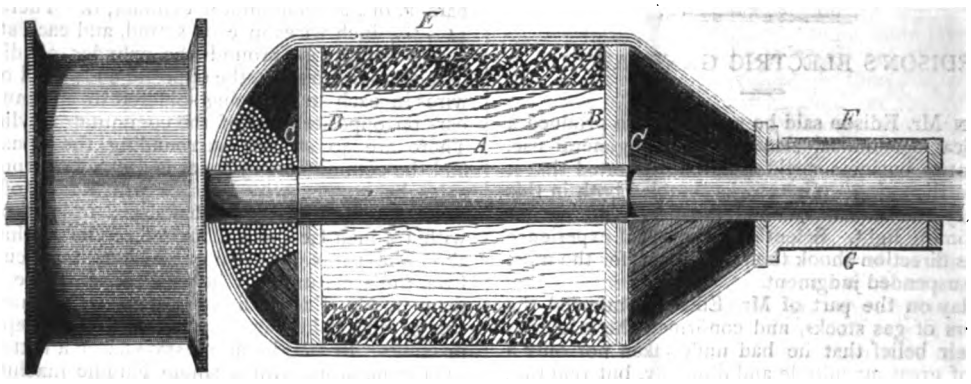

FIG. 1.

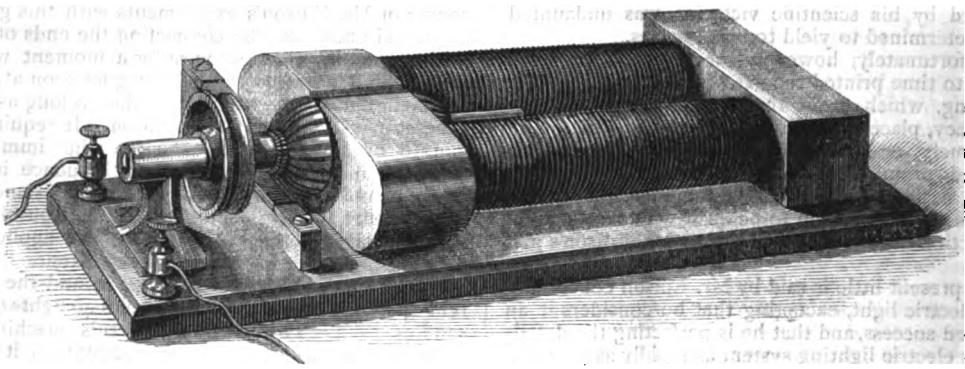

FIG. 2.

In Mr. Edison's generator 5 horse-power is transferred upon a resistance of 5 ohms, of which a $\frac{1}{2}$ ohm is in the machine, thus delivering $\frac{9}{10}$ of the total current upon a circuit exterior to the machine; thus nearly the maximum economy is attained when other machines, under like conditions, will scarcely give any current at all.

In dealing with the electric light problem, Mr. Edison has very properly devoted a large share of time and attention to the production of an economical generator, as it is the very foundation of the system. It bears the same relation to electric lighting that the cheap production of gas does to gas-lighting. It is as important to generate electricity cheaply as to use it economically. Mr. Edison slightly from the electric generator. The armature is arranged parallel with the magnet instead of transversely, and the magnet is formed of a single casting. In other respects it is like the generator, having the same form of armature, also commutator, cylinder, and brushes. The engraving represents the motor about one-fourth of its real size.

Whatever may be said or thought in regard to Mr. Edison's progress in electric lighting, it cannot be denied that he has made important discoveries which must tend to cheapen the electric light generally, and when he shall have completed his electric lighting system we hope he will reap the reward merited by his untiring perseverance.—*The Scientific American.*

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Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

ELECTRO-SOLAR ALARM.

SIR,—I read in your interesting Journal that an electro-solar alarm *has been invented*, by which a bell is rung when the sun passes the meridian. Already certain French journals had reported that so-called invention with a great fuss, and I did not think it worth while to claim it, because of its small importance; but since the TELEGRAPHIC JOURNAL, which is a serious organ, seems to attach some interest to it, I feel myself called upon to inform you *that this invention is only the germ of an apparatus which I designed and constructed in 1856 under the name of the Electro-solar Regulator.* You will find a long description of it in volume ii., page 255, of the second edition of my work on the Applications of Electricity, published in 1856. That apparatus aimed not only at indicating the moment of passage of the sun across the meridian, but also to adjust to the true meridian the hands of a clock, and thereby to indicate the true time. I described two plans for this purpose: but the second gave the best results. My descriptions are accompanied by very exact figures, which are engraved in plate vii. of the said volume.

This description is also reproduced in the fourth volume of my last edition, page 78. The idea has been taken up two years later by M. Régnard, and in 1868 by the Abbé Candido de Leece.

I beg you to accept the assurance of my best sentiments,

DU MONCEL.

Libisy, near Caen, Oct. 18th.

LIGHTNING CONDUCTORS.

SIR,—In the summer of 1878 delegates were nominated by the following societies, viz., the Royal Institute of British Architects, the Society of Telegraph Engineers, the Physical Society, and the Meteorological Society, for the following purpose:—

"To consider the possibility of formulating the existing knowledge on the subject of the protection of property from damage by electricity, and the advisability of preparing and issuing a general code of rules for the erection of lightning conductors."

The delegates have held several meetings, and have already collected, firstly, from the manufacturers of lightning conductors, and secondly, from the members of the Royal Institute of British Architects, a large amount of thoroughly practical information. Several of their number are also engaged in forming abstracts of the salient features of the literature of the subject.

The members of the Conference are, however, most anxious that their report should be as trustworthy and as exhaustive as possible, and they have therefore instructed me to ask you to assist them by publishing this epitome of their proceedings, and allowing them to invite correspondence upon the points mentioned below.

I am, Sir, your obedient servant,
G. J. SYMONS, F.R.S.,
Secretary to the Conference.

LIGHTNING ROD CONFERENCE,
30, *Great George Street, S.W.*

CLASS OF FACTS MOST REQUIRED.

Full details of accidents by lightning, stating especially whether the building struck had a conductor or not. If there was a conductor, state its dimensions—construction—mode of attachment to building—whether its top was pointed—distance of its upper terminal from the place struck—nature and extent of the connection between the conductor and the earth, and whether the earth was dry or moist—whether the conductor was itself injured—and whether the conductor or the point struck was the most salient object in the vicinity. Information is also desired, either verbally or by sketches, as to the position of metal spouting and lead roofing relatively to the point struck, and to the conductor.

Details of the thickest piece of metal melted by a flash of lightning are much needed.

Unimpeachable evidence of the failure of conductors is much desired, as such failures would be extremely instructive.

SUBSCRIBER, T. W.—We hope soon to obtain further information respecting the subject of your query.

Notes.

PROTECTING CARBON ELECTRODES.—The practice of coating carbons with copper to preserve them from consumption by ordinary combustion, is to a certain extent defective, by reason of the white-hot carbon oxydising the copper itself. This fault has been remedied by Mr. Willey, an American, who first covers the carbon with a thin coating of plaster of Paris, and then coats it with copper by galvano-plasty. This has the effect, according to Mr. Willey, of making the duration of the carbons ten times longer, and giving a much more tranquil light.

THE RADIOMETER UNDER MAGNETISM.—A German experimenter, Herr Basso, recently brought an ordinary radiometer with four mica vanes blackened on one side, rapidly rotated by the light of a gas flame, under the influence of a strong electro-magnet. The result was a slight reduction of the velocity of rotation, caused, perhaps, by magnetic action on the vanes, and on the oxygen of the air, and perhaps, also, by electric currents produced by the motion of the vanes.

THE TELEPHONE AND BALLOONS.—Two French balloons, the *Européen* and the *Observatoire Aérien*, made a recent ascent from the Villette factory, Paris, connected by a telephonic cable, which, however, had to be cut on the balloons taking different courses.

ELECTRICITY IN THE HOUSE.—A small pamphlet on this subject by Messrs. Johnston & Co., gas engineers and electricians, will help to enlighten the public as to the conveniences of electric bells, fire and burglar alarms, &c., in the house.

MR. F. H. BROOK, Walworth, has issued a useful price list of electrical apparatus.

THE *Great Eastern*, which has been lying in the Medway, Sheerness, for some time, is, we hear, to be fitted with new boilers and engines at a cost of £100,000, and is then to carry cattle from Texas to London.

TELEGRAMS IN FRANCE.—Eleven million telegrams were sent in France during the year 1877, or about one for every three inhabitants. In Belgium during 1878 two millions were despatched, making about one for every two and a half inhabitants. In that country the

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tax for "urgent" telegrams is double the ordinary tax, and the number amounts to about two per cent. of the whole.

INTERNATIONAL telegrams between Belgium and Holland will be charged henceforth at five centimes per word, with an obligatory maximum of ten words.

THE Eastern-Extension Telegraph Company are taking steps to lay the long-talked-of cable from Hong-Kong to Manilla.

THE recent hurricane and floods in Andalusia, Spain, have, more or less, destroyed all the railway and telegraph lines in the province.

THE French ministry of war have organised a system of optical telegraphy, and placed it under the supervision of the director of aerial communications, who manages the balloon and carrier-pigeon service.

THE Japanese telegraph system is to be completed in two years.

AMERICAN meteorologists are proposing light-ships and observatories to be moored on the Atlantic, and placed in communication with the submarine cables there so as to transmit weather reports. (!)

THE TELEGRAPH WAR in America is at last settled, and an agreement has been signed between the two rival companies to the effect that: The poles of the American Union Company are to be placed forty feet high, allowing seven arms or less to each pole, the wires to be strung twelve feet clear, and below those of the Western Union Company's wires, where the poles of the two companies are placed in proximity to each other. All suits are to be discontinued without loss to either party; there is to be no prosecution of the employés of either company, and both companies agree to in no way hinder the other in the prosecution of their work. The agreement is to remain in force for one year. Immediately after the signing of the agreement the work of putting the entangled wires in order was resumed. The lines of the American Union Company are being errected at the rate of 100 miles a day; but it is expected that they will not now be ready for business till November 1. They will then open with 10,000 miles of wire, in addition to the Dominion lines leased some time ago, and from 400 to 500 offices in circuit.

THE ZANZIBAR AND ADEN CABLE.—The Telegraph Construction and Maintenance Company's steamers Scotia and Zanzibar have been despatched from London with the Zanzibar to Aden section of the Cape cable, and the company expect that communication beween Aden and South Africa will be open before the end of December. The Mozambique-Zanzibar section was completed on October 3rd.

THE LIBEL on Colonel Croll, director of the old United Kingdom Telegraph Company, by the *Investigator* newspaper, came before the Recorder on October 24th. Mr. Metcalfe, who appeared for the prosecution, stated that in 1861 the plaintiff and a number of other gentlemen of position and eminence were directors of the United Kingdom Telegraph Company, and it appeared that there had been disputes between a person named Allen and the directors, from whom Allen claimed a large sum of money. The learned counsel detailed the various proceedings in the law court connected with this claim, and said that in every instance he was defeated, and the directors were completely exonerated from any liability, either legal or moral, but they were put to heavy costs, none of which, or a very small portion, were ever paid. In 1868 the different telegraph companies were taken over by the Government; and although a large sum no doubt was paid to the company, it was a most profitable bargain, and he believed that but for certain circumstances that existed at the time the directors would have required a much larger amount. After the transaction had been completed a charge was made against the directors of having defrauded the Government of £400,000 by means of false and fictitious entries in the books of the company. An investigation was ordered by the House of Commons; a full inquiry took place; every facility was afforded to the parties to prove the truth of the charges they had made; but they utterly failed, and the report of the committee of inquiry upon the subject was that there was not the slightest shadow of foundation for these charges, and the directors were completely exonerated. Notwithstanding this, the defendant, in July of the present year, started a publication called the *Investigator*, and in that journal he raked up the whole of the previous proceedings, and distinctly charged Colonel Croll with having defrauded the Government in the way stated. Mr. Houghton, who appeared for the defendant, Mr. Isaac Montgomery Gadd, proprietor, pleaded guilty to the charge, and withdrew the former plea of justification. The Recorder sentenced Mr. Gadd to four months' imprisonment.

VARZIN, the Pomeranian residence of Prince Bismarck, is, of course, in telegraphic communication with Berlin, and it is stated that as many as 650,000 letters and 10,000 telegrams passed through during a recent year for the great Chancellor, who, by the way, only resides there during summer and autumn.

WE regret to hear that Mr. T. Edison, nephew of the famous electrician, whose figure became familiar to us during last winter, has just died from consumption in Paris, where he went to look after his uncle's patents.

CITY AND GUILDS INSTITUTE.—The City and Guilds of London Institute for the Advancement of Technical Education announce the opening of their Technical Classes, at Cowper Street School, Finsbury. In the Section of Applied Physics, Mr. W. E. Ayrton will deliver a course of 12 lectures on "Some of the Practical Applications of Electricity and Magnetism," commencing Monday, November 3rd, at 7 p.m. In that of Applied Chemistry, Dr. H. Armstrong, F.R.S., will deliver a similar course on "The First Principles of Chemistry," commencing Wednesday, November 5th, at 8 p.m. An Inaugural Lecture will be delivered by Mr. Ayrton, on Saturday, November 1st, at 8 p.m., on "The Improvement Science can Effect in our Trades, and in the Condition of our Workmen." A syllabus of each Course of Lectures can be obtained at the Halls of the Companies of Mercers, Clothworkers, and Drapers, or at the Schools, Cowper Street, Finsbury. Intending students should send in their names to the Demonstrator, Cowper Street Schools, Finsbury, E.C. The Inaugural Lecture will be free. The aim of these lectures will be to train the students, by an examination of the machines, instruments, &c., employed in the arts (or of models of them), to turn their attention to the scientific principles governing the action of these machines, without a knowledge of which neither their proper working can be ensured nor improvements in them effected. It is believed that this analytical method of experimental instruction will, for the class of students expected to attend, be preferable to the ordinary method

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adopted in the teaching of natural philosophy, which consists in much time being first spent in the study of the elementary principles, and then only subsequently the practical applications explained. The lectures will be given on Mondays at 7 p.m., and Fridays at 8 p.m., commencing Monday, the 3rd November.

November 3, 7, 10, 14, 17, 21, 24, 28.
December 1, 5, 8, 12.

New Patents—1879.

4082. "Greatly increasing the speed of working submarine cables and underground wires or telegraphic lines." T. J. JONES. E. BULL. Dated Oct. 9.

4170. "Means and apparatus for interlocking the telegraphic block instruments with the points and signals of railways." C. HODGSON. Dated Oct. 15.

4189. "Electric telegraph terminal and shackle insulators." C. E. CREIGHTON. Dated Oct 16.

4306. "Improvements in automatic contact-breakers for electric bells and other electric or galvanic circuits." T. WILKINS. Dated Oct. 22.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

805. "Magneto-electric apparatus." W. P. THOMSON (communicated by W. W. Gary, Washington, U. S.). Dated Feb. 28. 6d. This describes a magneto-electric machine in which the armature moves in the magnetic field to and across a neutral line. It is an improvement on patent 2364, 1877, and contains the principle of the exploded "Gary motor."

830. "Electric lamps." G. G. ANDRÉ. Dated March 1. 8d. This consists in an electric lamp for mines. A series of thin carbon rods resting on a larger piece of metal or carbon form the electrodes. The smaller rods slide easily in tubes and are lightly pressed by weights on the larger electrode. The current is passed from the small to the large carbon and the point of the former is rendered incandescent thereby. By means of a commutator one of the carbons only is kept in a state of incandescence at a time, and when it is inoperative the next is put in circuit. The carbons are enclosed in a glass cylinder containing nitrogen and carbonic acid, to prevent explosions, and also to prevent wasting of the carbons. The glass cylinder may be silvered at the top or fitted with reflectors to diffuse the light. The lamp may be made to stand or hang.

854. "Producing and converting electric force into motive power." H. POST and T. VARLEY. Dated March 4. 2d. Electricity is got from a trough battery, turned into magnetism by electro-magnets, and into motive power by a movable armature. Induction plates are used in connection with the battery to wipe out the residual magnetism of the cores of the electro-motor at each break of the actuating current. *(Not proceeded with.)*

876. "Electric lighting." J. B. SPENCE. Dated March 15. 2d. Between electrodes of platinum (cooled by circulation of water) a current is passed so as to form an arc, and into it a flame of gas, oil, or spirit, or else a carbon point, is inserted. The result is a highly intense electric light. *(Not proceeded with.)*

925. "Electric lamps." K. W. HEDGES. Dated March 8. 6d. This consists in preparing magnetic carbon electrodes for lamps by attaching to them wires or strips of iron, or mixing iron filings or magnetic iron ore with them, or depositing a layer of iron on them. They are then placed in tubes or guides in which they can freely slide towards each other, or one may be stationary or moved by a weight or spring or by flotation, whilst the other is arranged so as to descend by its own weight towards the other. Near the carbons so mounted poles of an electro-magnet are placed, so that when excited by a strong current they will attract the magnetic carbons and thereby retard or allow their motion. In this way the regulation of the arc is effected.

City Notes.

Old Broad Street, Oct. 29th, 1879.

THE war between the old Atlantic cable companies and their new rival, "La Compagnie Franqaise du Télégraphe de Paris à New York," which every one has foreseen for some time past, is at last declared. Mr. Weaver, the esteemed general manager of the Anglo Company, has publicly notified that from the day of the opening for traffic of the new company, the tariff of the Anglo Company, *via* Valentia or *via* Brest, for messages between the United Kingdom or France and New York and Canada, will be reduced to 6d. and 60 centimes per word respectively. He also notifies that a new cable will be laid for the Anglo Company in 1880, in order to provide for the large increase of business anticipated, as the probable result of the above reduction of tariff. It is to be feared that at the 6d. rate no dividends can be paid by either of the companies, and it is not unlikely that the receipts will not suffice to cover their working expenses. The number of messages sent will naturally increase, perhaps considerably, and provided all the cables were equal in sending capacity, the Anglo Company should be able to get through most work in a given space of time, because of its greater working capacity. It would, however, be interesting to know what is the working rate of the existing cables; various rumours are afloat, but we should like to have some authentic information on the subject. What are the duplex systems going to achieve in this warfare? They should be of great assistance to the cables already complete. The Compagnie Franqaise will, without doubt, have possession of a cable of high electrical quality, and, were it not for the Direct United States cable belonging, practically, to the Anglo Company, the sending powers of both companies would not be so very unequal. As another cable is to be laid in 1880 by the Anglos, there would seem to be need of more ways of communication, notwithstanding the introduction of duplex working. The new company, it will be remembered, also propose to lay a cable in the spring of next year. The Faraday has arrived on the other side of the Atlantic with the last portion of the new cable, and we may therefore soon expect to hear of the successful completion of her task.

Much opposition, we learn from America, is to be offered to the landing of the shore end on the other side of the Atlantic, and also injunctions are being prepared against the use of the wires of the American, and the Baltimore, and Ohio Telegraph Companies by the French Company, but we doubt if these efforts will arrest the progress of the opposition.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY.—The fifth ordinary general meeting of this company was held on Wednesday, October 22nd, at the City Terminus Hotel, Mr. C. W. Earle presiding. The chairman, in moving the adoption of the report and accounts (an abstract of which appeared in our last issue), remarked that, "The history of the company was one which went far to disprove the suggestion

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contained in the old saying of it being a long lane that had no turning. They had travelled that lane for some time, and although they had thought they saw rays of light occasionally coming across their path, it must be admitted that all those bright hopes had gradually faded away, and they could only come to the conclusion that, looked upon as a field for telegraph enterprise on a commercial basis, the West India colonies were unprofitable. It was said that the man who waited long enough always got what he wanted, but, unfortunately, in their case, while they were waiting the cables on which they depended were running through their span of natural existence, and were approaching that decay which must end in the cessation of their operations, and, unfortunately, during their lifetime they had not been able to put by such reserves as were sufficient to relay or restore them when they ceased to work. With these facts staring them in the face, it was natural to ask, what was their policy? Were they to see their cables gradually dying out before their eyes, and to see the eventual loss—he did not say when it was to occur—of a great part of the capital sunk in the endeavour to connect the West Indian colonies with the rest of the world by telegraph, and were the colonies to be deprived—to lose, in fact, their communication with the home country, which in these days almost every colony of any size or importance thought it necessary to have? The only policy that they had—they had tried everything they knew of—was to continue their importunity with those who were so largely concerned in having a continuance of the system." He also remarked, "He had been struck with an article in the *Colonist* of Demerara, an article which contained, in the midst of a great deal of common sense and liberality of feeling, some reflections on the company which were not deserved. The article, he might say, did not entirely approve of the policy of the Government in this matter, but it traced the cause of their unfortunate position and their impecuniosity to their own folly and bad policy, and particularly in the matter of high rates. Now, those rates were fixed originally by the colonies themselves. The rate originally was for 20 words. Soon after the company was formed a very great concession was made by the company to the public of those colonies, for they diminished the minimum of 20 words to 10 words, charging only half the rate fixed for 20 words. It was very much less remunerative to carry a 10 word message at half the rate hitherto charged for a 20 word message. When the present board took office the 10 word rate was in force, and they found after working for two or three years with the system in complete order that there was not revenue enough to pay their working expenses, pay the small dividend they did on two or three occasions, and put by sufficient money for the renewal of the cables. They then applied for an increase of the rates, and the higher rates they were allowed to introduce had resulted in an increased revenue of £18,500 a year. If it had not been for that policy of theirs and that increase of rates, they would hardly have been in existence now, for there were many things they would have been perfectly unable to carry out. He thought it a pity, therefore, that people should have such an erroneous idea, and prejudice the minds of their fellow colonists in this manner." He then moved the adoption of the report and accounts, and the payment of the dividends recommended on the First and Second Preference Shares. Mr. William Ford, a director, seconded the motion. Mr. William Abbott thought that the Chairman had attached too much importance to the article in the paper he had referred to. He thought that the directors should go on and administer the affairs of the company as they considered best in the interests of the company. He would like to know, as the report was only to the 30th of June, whether the colony of Demerara had really deducted the subsidy. He thought it would be a very awkward time for that colony to be on bad terms with the company, looking at the very general rise which had taken place in everything the West India islands produced. The Chairman, in reply to questions, said they had entered into a contract for picking up the Investigator for £14,500, and it was expected that the vessel and its machinery would be picked up for £16,000. They had had no offers from the underwriters with respect to the vessel, and the claim for the amount of the insurance was awaiting settlement at law. They had received information that up to the present Demerara had withheld the subsidy. The motion was then put and carried unanimously.

EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY, LIMITED.—The twelfth ordinary general meeting of the shareholders of this Company was held on Wednesday, October 22, at the City Terminus Hotel, under the presidency of Mr. J. Pender, M.P. The report, an abstract of which appeared in our last issue, having been taken as read, the chairman said: Then before putting the resolution to the meeting for its adoption, I will, as usual, give you a few figures on the working of our system. As stated in the report, the gross receipts for the half-year ending the 30th of June, 1879, were £150,107, against, for the corresponding period of 1878, £135,482, showing an increase of £14,624. The expenses for the past half-year amounted to £65,509, against, for the corresponding period of 1878, £61,222, or an increase of £4,287. This is more than covered by the expenses of keeping three repairing vessels during the last half-year instead of two, as in the corresponding period of 1878, and by carrying an additional £1,000 to the maintenance ships' reserve fund. But for this a saving of about £2,300 would have been shown. The screw steamer, Edinburgh, has now, however, been sold, as stated in the report, for £10,000. The net revenue for the half-year under review was £84,597, in the corresponding period it was £74,260, being an increase of £10,337. Two interim dividends of 1½ per cent. each, absorbing £49,937 10s., have been paid for the half-year, leaving a balance of £34,660 to be carried forward. As to the duplicate Australian cable, the first section of it was successfully laid and opened for traffic on the 16th of August last, and connected Malacca. This was done by arrangement with the Government of the Straits Settlements, who have to pay the company an annual subsidy of £1,000 for ten years. A considerable portion of the second section between Singapore and Java has been laid, and a vessel with the necessary cable to complete the section is now on her way to Singapore. We anticipate that the contractors will complete the whole work in the early part of next year. The articles of association state that in case of a vacancy in the auditorship it shall be filled up by an extraordinary general meeting. As, however, Mr. Ball's death took place so recently, the directors considered it unnecessary to call a meeting specially for the appointment of a successor, and therefore requested Mr. Ball's firm to complete the audit to the 30th of June. The vacancy will be filled up at the extraordinary meeting which is to be held at the conclusion of this meeting. Now, gentlemen, I have given you certain figures, or rather made certain comments, upon the report which you have in your hands. I may now say a few words, and those of congratulation, on the general improvement of our traffic. I have stated that up to the end of

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the half-year ending 30th June last we have shown a net profit over the corresponding period of the previous year of £10,000. From that time up to the present I am glad to say that our traffic has generally been very successful indeed—in fact, I may say that we are having now the best traffics we have ever had, and this may be to a certain extent accounted for in two ways. There is the Exhibition going on at Sydney for the present month, and there is a general improvement in trade. I have very often said at these meetings that our telegraph system is a very good barometer of trade. With bad trade we suffer, with good trade it is quite remarkable the buoyancy that takes place, and I hope that the improvement which is now pretty well acknowledged to exist will be maintained. You know that we have always been told that any improvement was to come from America. Well, America is very rampant at the present moment, and that is also testified by the returns on the Atlantic cable system. I have often also said that the importance of duplicating your cable was very great indeed; and I may mention that while our cable has no interruption at the present time, yet, had we not laid down our duplicate system—or that portion between Singapore and Penang—we should have been at a standstill. The original cable is now interrupted, and the whole system would have been interrupted. Fortunately this duplicate was laid down in time, and we are reaping the benefits of additional security and also of the improved traffic. I am glad also to tell you that, with regard to the duplicate cable which we are under contract to have completed by the end of February next, that we were enabled, without any loss or sacrifice on our part, with the sanction of the Australian Government, to give the home Government evidence of our desire to help them in having the Cape cable established; and I am glad to say this, notwithstanding our helping them in this object, the duplicate system will, I believe, be completed very early next year, or nearly two months before the contract time (hear, hear). I am also glad to tell you that Colonel Glover has visited all our stations. He was absent from London for something like eighteen months, and he has been able to give us a report of the working of our system, and I am glad to say that this visit has been of very great good, as you can well conceive. Our young men like to see their managing director among them, and I believe that Colonel Glover's visit has been productive of very great good. We were also able to avail ourselves of his presence in Australia to carry to a successful issue the negotiations with the Australian Governments. To do this Colonel Glover had to get them into a spirit of harmony for the benefit of the whole, which is rather a rare thing to get done. Each thinks that he knows better than his neighbour, but in this particular business of the duplicate cable they seem to be pretty well in accord. Colonel Glover has travelled during the time he has been away something like 40,000 miles. I am also pleased to say that up to the present time the experimental system of sheathing our cables with a brass coating has been successful. With these remarks, gentlemen, I think that I have pretty well exhausted all that I have to say to you, except this—that, as you are all aware, an important conference was recently held in London of the telegraph representatives of every Government, certainly of Europe, which laid down certain laws. We had not a seat at that conference, but so far we have always felt that we have been fairly dealt with by the conference. There is, however, a difference of opinion among some of the merchants at the present time, who think that they have been more or less aggrieved by certain alterations that have been made. But I will only make this remark—that we have no power to alter what has been done. We have certainly the power of receiving communications from merchants who feel themselves aggrieved, but I would say to those merchants that, looking to the history of submarine telegraph progress, up to the present time they have certainly had the best of it (hear, hear). They have dealt with the code system to an extent that was never contemplated. Had the original prospectus of this company been carried out, we should have been paying you to-day probably 35 per cent. instead of 5 per cent., and, therefore, the merchants have no cause to complain. They have done all they could—they have used their utmost ingenuity. I do not blame them for this. I think it quite reasonable that they should have the greatest amount of traffic carried at the smallest expense; but, on the other hand, they must take care not to kill the goose that lays the golden eggs (hear, hear). If any merchant feels himself aggrieved I shall be very glad to meet him and discuss the question, and I am satisfied that I will show him that the greatest benefit of the system has been with him and not with the shareholders. With these remarks I beg to move the adoption of the report. The resolution is—"That the report and accounts of the directors now submitted be received and adopted." The Right Hon. W. N. Massey, M.P., the Deputy-Chairman: I beg to second that. After some further remarks as to the appointment of an auditor in the place of the late Mr. John Ball, and the report and accounts having been adopted, the proceedings terminated.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY, LIMITED.—The twelfth ordinary general meeting of the shareholders of this company was held Oct. 28th, at the City Terminus Hotel, Cannon Street, under the presidency of Viscount Monck, chairman of the company. The chairman, in moving the adoption of the report, pointed out that the revenue for this period amounted to £75,083 13s. 11d.; the working expenses to £13,452 14s. 4d., leaving a balance of £61,630 19s. 7d. To this is added £23,301 16s. 9d., the undivided profits to 31st December last, making a total of £84,932 16s. 4d. After deducting income tax (£832 11s. 9d.), there remains a balance of £84,100 4s. 7d. A third interim dividend, amounting to £16,250, has been distributed since the last accounts were presented, leaving the sum of £67,850 4s. 7d. for appropriation. The directors now recommend the declaration of a final dividend of 2s. 6d. per share, free of income tax, making a total dividend of 5 per cent. for the year ending 30th June, 1879, which will absorb £16,250, leaving a balance of £51,600 4s. 7d. Of this amount £50,000 has been placed to the reserve fund, increasing that fund to £227,437 8s., and £1,600 4s. 7d. carried forward. Upon these figures he (the chairman) thought it was not necessary to observe at any great length. The report and accounts told their own tale. The object the directors had in view was to frame their report in a perfectly intelligible form so as to enable a comparison of one year with another to be drawn at a glance. The receipts of the past half-year, compared with the corresponding half-year of 1878, showed an increase of £5,000. But it should be remembered that the war in South Africa had brought grist to the mill, and they had carried a considerable amount of news from Madeira. Added to this, there was also an increase of 15 per cent. in ordinary messages. The speaker then referred to the unfortunate agreement which existed between this company and the Western Brazilian Telegraph Company, but with the assistance of the legal adviser of the board he hoped to be able to mitigate the evil of this unfortunate agreement. If they succeeded in getting rid of that agreement the profits of the company would largely increase. It would also be

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seen that there had been a considerable reduction in the normal expenses of the company, the percentage of the working expenses on the earnings being 15½ per cent. The cables continued in good working order, and were carrying traffic as well as possible. The reserve fund was growing, but until it reached a sum much larger than the present amount it would, in his opinion, be very unwise not to lay by every penny after the payment of the dividend of 5 per cent. The chairman concluded by formally moving the adoption of the report and accompanying statement of accounts. Sir James Anderson seconded the motion. Several shareholders, amongst whom were Mr. Warwick, Mr. Jenner, Mr. Holdsworth, Mr. Marcus, Mr. Griffiths, Mr. Nates, and Mr. Spicer, raised objections to carrying so large a sum as £50,000 to the reserve fund, whilst only paying a dividend of 5 per cent. Up to a certain point no doubt it was a wise policy to add as largely as possible to the reserve fund, but this surely was not to go on in perpetuity. In reply to these observations the chairman reminded the meeting that the reserve fund continued their property as much as the cable itself. This reserve fund was being laid by so that in case a new cable were required they might have the money at their back to replace it instead of being compelled to call in new capital, and thus render their 5 per cent. perpetual. Other companies laid by their reserve fund first, and divided what was left amongst the shareholders, whereas this company acted differently, securing in the first instance the 5 per cent. and handing over what was left to the reserve fund. At present they had barely enough to replace the shortest section of the cable. The cost of an entire new cable would be probably something between six and seven hundred thousand pounds. The resolution was then put from the chair and carried with four dissentients. The directors retiring by rotation and the auditors having been re-elected, Mr. Spicer moved a resolution to the effect "That the board be requested not to add more than £30,000 per annum to the reserve fund from this time." The motion, which was seconded by Mr. Murch, on being put from the chair, was declared lost, there being 20 for and 22 against. The proceedings closed with the usual compliment to the chairman.

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The Board of this Company have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum for the quarter ending 30th September, 1879, such dividend to be payable on and after the 15th November, 1879.

THE Chairman of the Eastern Telegraph Company has received a telegram from Aden announcing the completion by the Telegraph Construction Company's ss. Calabria of the Mozambique-Zanzibar section of the cable from Natal to Zanzibar.

THE India-rubber, Gutta-percha, and Telegraph Works Company successfully laid the Caspian Sea Cable on October 14th. The same company have also completed the laying of the French Government Cable from Marseilles to Algiers. Another cable to Wexford is being made by them for the Postal Telegraph Department.

WE hear that the estimate for the New Zealand Cable sent in by the Telegraph Construction Company, has been accepted, but that company's steamer which it was intended should take out the cable having sailed, they now decline to abide by the terms of the said estimate. Offers for making and laying will therefore, we presume, be again required.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 55-56; Ditto, Preferred, 80½-81½; Ditto, Deferred, 30⅜-31⅜; Brazilian Submarine, Limited, 7⅛-7⅜; Cuba, Limited, 7⅛-8¼; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 1⅞-2¼; Direct Spanish, 10 per cent. Preference, 10⅞-11¼; Direct United States Cable, Limited, 1877, 10⅛-10½; Eastern, Limited, 8-8½; Eastern, 6 per cent. Debentures repayable October, 1883, 103-106; Eastern 5 per cent. Debentures repayable August, 1878, 103-105; Eastern, 6 per cent. Preference, 12-12½; Eastern Extension, Australasian and China, Limited, 8¼-8⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, ⅛-⅛ pm; Ditto, registered, repayable 1900, 1-2 pm; German Union Telegraph and Trust, 7⅛-7¼; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 11-11½; Great Northern, 8⅜-8¾; Indo-European, Limited, 22½-23½; Mediterranean Extension, Limited, 2⅞-3¼; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Reuter's Limited, 9-10; Submarine, 225-230; Submarine Scrip, 2-2¼; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference 7⅛-8; Ditto, ditto, Second Preference, 7-7⅛; Western and Brazilian, Limited, 3⅜-3⅝; Ditto, 6 per cent. Debentures "A," 98-102, Ditto, ditto, ditto, "B," 94-99; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 123-128; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 33⅛-34; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2⅞-3; India Rubber Co., 12½-13; Ditto, 6 per cent. Debenture, 104-108.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
September, 1879	63,240	*10,935	3,000	1,121	21,080	39,369	25,980	18,775	... ...	11,911	725	11,719	4,178
September, 1878...	44,310	10,463	2,463	1,048	14,770	38,169	22,151	15,778	... ...	9,661	2,200	... ...	3,877
Increase	18,930	472	537	73	6,310	1,200	4,829	2,997	... ...	2,250	... ...	... ...	301
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	1,475	... ...	... ...

* Four weeks only.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 163.

THE LATE PROFESSOR CLERK-MAXWELL.

ELECTRICAL SCIENCE has sustained a severe loss in the premature death of one of its theoretical masters, Professor James Clerk-Maxwell. Maxwell's great work on Electricity may be called the Principia of the subject on which it treats, and it has carried his fame into all civilised countries. The death of its author at the comparatively early age of 48, the age when an intellectual worker is in his prime, will come upon most of those who are familiar with his name and labours with a kind of shock, for it was confidently believed by those best fitted to judge of his powers that high honours and great achievements were yet in store for him. Death, however, from whose darts the brightest genius is no safeguard, has stepped in, and put an end to these confident hopes. After an illness of a few weeks the Professor died at his residence in Scroope Terrace, Cambridge, on Wednesday, November 5.

James Clerk-Maxwell was a native of Edinburgh, where he received his schooling, and entered Trinity College, Cambridge, as an undergraduate in 1850. In 1854 he graduated as Second Wrangler, taking his B.A. degree, and was elected a Scholar of the College. In the contest for the Smiths prize he was declared equal in merit with Mr. E. J. Routh, the Senior Wrangler of that year. Next year he was elected to a fellowship of Trinity, and the following year, 1856, he was appointed Professor of Natural Philosophy in Marischal College, Aberdeen. In 1860 he came to London as Professor of Natural Philosophy and Astronomy in King's College, which chair he held until his nomination to the chair of Experimental Physics at Cambridge in 1871, on the establishment of this new chair in the University and the erection of the excellent Cavendish Laboratory for the prosecution of physical research. Here his principal duty consisted in teaching and illustrating the laws of heat, electricity, and magnetism, and in advancing our knowledge of these subjects and their study at the University. "For the last eight years," says a writer in the *Times*, "Professor Maxwell has laboured assiduously, both in term and vacation, to carry out the objects of the professorship, and has succeeded in attracting an unusual number of earnest students, many of whom have highly distinguished themselves in the mathematical Tripos. The Chancellor of the University has taken a great interest in Professor Maxwell's work, and it was through the Duke of Devonshire's munificence that the magnificent Cavendish Laboratory, over which Professor Maxwell presided, was erected and supplied with necessary appliances. So important was the study of physical science considered that in 1874 a Demonstrator was appointed to assist Professor Maxwell. By a curious provision that professorship terminates with the death of the Professor, unless the University shall determine to continue it. There can be little doubt that it will be decided to continue the professorship, although it will be extremely difficult to find a successor so eminently qualified as was Professor Maxwell."

This distinguished scientist was apparently at his best as a mathematician, dealing with physical phenomena, and as such belonged to the school of Sir William Thomson, together with Professor Tait, Dr. Joule, and others. His miscellaneous works are to be found scattered among the *Transactions of the Royal Society*, of which he was a Fellow, the *Cambridge and Dublin Mathematical Journal*, the *Transactions of the London Mathematical Society*, and those of the Cambridge Philosophical Society; but his reputation as a scientific investigator is also acknowledged by the scientific world. Besides his chief work on "Electricity" he also wrote a small handbook on "The Theory of Heat," published by Macmillan & Co., which has already run through four editions. His style was singularly lucid, terse, and yet polished, it was in short the perfection of a purely scientific style; and his superabundant wit and humour occasionally burst from the restraints of severer thought and found vent in the more liberal forms of poetry. Under the *nom de plume* of $\frac{dp}{dt}$ his physico-comic parodies of well-known verses have appeared from time to time in our contemporary *Nature*, and caused considerable amusement.

Professor Maxwell has filled the office of Examiner and Moderator for the Mathematical Tripos on several occasions. He has also been President of the Cambridge Philosophical Society, and our readers will hardly need to be reminded of the fact that he delivered the Rede Lecture on the "Telephone" last year, a lecture which was not only an exquisite model of its kind, but the most searching exposition of the subject which has yet appeared. He was an Honorary Fellow of Trinity College, a distinction which he shared with the Astronomer Royal, the Poet Laureate, and Lord Houghton.

WE are requested to state that the Picton Reading Room, Liverpool, is being illuminated by the British Electric Light Company by Serrin lamps, and not by Werdermann lamps, as stated in our issue of Oct. 15.

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A CHLORIDE OF LIME BATTERY.

By ALFRED NIAUDET.

THIS battery has for its positive electrode a plate of zinc, and for its negative electrode a rod of carbon surrounded by fragments of the same material.

The zinc is plunged into a solution of common salt; the carbon is placed in chloride of lime contained in a porous cell of either porcelain, canvas, or parchment paper.

The chloride of lime is, as is well known, a mixture of hypochlorous acid and lime; the acid seems well suited for depolarising the negative electrode, because its two component parts can both of them combine with hydrogen to form, on the one hand, water, and on the other hand, chlorohydric acid. This acid can attack the zinc and produce chloride of zinc; or it can attack the lime and produce chloride of calcium; these two salts are very soluble and very good conductors of electricity. The choice of the substances employed is such that the combinations which take place are soluble and conductive. It is possible that certain double salts are formed, as is the case in all batteries; but if this is the case they are soluble, as experiments with the batteries show.

The zinc in the presence of the chloride of lime is not sensibly attacked, and consequently batteries with these elements can remain for an indefinite period without waste; action only commences when the circuit is closed. This property is, as is well known, of great importance in many cases.

We will now consider the reason for employing chloride of sodium; the advantage is, that it is the cheapest of all salts without exception. The solution is the best liquid conductor known. But there is still another advantage: a great number of other salts and other liquids have been tried, notably sal-ammoniac, the hypochlorite of soda highly concentrated, the chloride of lime, diluted sulphuric acid, but all have given less satisfactory results and a lower electro-motive force than common salt. The reasons of these inferiorities are undoubtedly very various; the defect appears to arise from the formation of an insoluble sulphate of lime which stops the further action of the battery.

The electro-motive force of the new battery is found by experiment to have a maximum value of 1·6 volts., which falls to 1·5 after several months' use.

The depolarisation produced by the chloride of ime is not complete or instantaneous, as it is in sulphate of copper batteries; if the battery is worked through a low external resistance the electro-motive force falls, as is the case with almost all batteries. But this force regains its normal value quickly. In an experiment, the electro-motive force being found to be equal to 1·39, the circuit was closed through a resistance of 1 ohm for 40 minutes, the force was then found to be reduced to 1·13, but at the end of 40 minutes, the circuit being open, it had risen to 1·29, and in two hours to 1·38.

The internal resistance of the battery is comparatively low; great care having been taken to reduce it as much as possible. The zinc is placed very near to the porous cell and completely surrounds it; but is prevented from touching by a simple device.

The smell of the chloride of lime is hardly sensible even with the ordinary batteries, because care is taken to seal the porous cell at its upper part with asphalte, which protects the salt from the air and at the same time keeps it securely in the cell. The outer cell can also, if necessary, be hermetically sealed, as is sometimes done with other batteries.

THE IMPROVEMENTS SCIENCE CAN EFFECT IN OUR TRADES, AND IN THE CONDITION OF OUR WORKMEN.*

By PROFESSOR W. E. AYRTON.

TRADE is bad, horribly bad! The causes of this depression, which meets us on every side, it is not difficult to ascertain—inability to compete with the foreigner in the production of what England consumes, combined with inability to trade economically in his own markets. We cannot, for example, now grow corn or rear cattle as economically as we can get them from America; so that while our land produces ten million quarters of wheat a year, we import as much as thirteen millions, whereas thirty years ago we grew fourteen millions (more, in fact, than at present), and imported only four million quarters per annum.

On the other hand, the Americans can manufacture machinery cheaper than we can sell it to them, in consequence of their high import duty of about 30 per cent.

We might say that this state of things arose from their having on the other side of the Atlantic vast pasture lands, a good climate, and protection; while we are cramped for room, inundated with rain, and luxuriate in the blessings of free trade.

It is not, however, only the demand abroad for English commodities that we see slowly dying away, but we find that even in our own country we are being gradually undersold in those productions which depend not on pasture lands, not on climate, but on the use of labour-saving machinery—the result of human ingenuity.

Our disappointment in witnessing the gradual disappearance of the foreign market for our manufactures may possibly be alleviated by our belief that the example we are setting of perfect freedom in trade will be ultimately for the world's good. But no ray of consolation can cheer the remembrance that our Coventry ribbon trade, that once famous industry created by ourselves, has well-nigh departed to Switzerland in company with the silk weaving industry of Lyons and Spitalfields. The Clerkenwell mechanic sees with no feeling of national pride the American machine-made watches pressing on his heels in the march of time. Even our trade in the bending of umbrella and stick handles is rapidly crossing the Atlantic, and several of our chemical industries are being absorbed by the Continent.

And what about those devices, those Yankee notions, as we call them, in which machinery replaces the old cumbersome and uneconomical hand labour—the sewing machine, the type-writer, for clear and rapid correspondence, the electric pen, for superseding lithography, duplex and quadruplex systems of telegraphy for multiplying the carrying capacity of a telegraph line, and that instrument for dispensing even with messengers,

* The Inaugural Address, delivered at The City and Guilds of London Institute, on Saturday, Nov. 1st, 1879.

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the telephone. Why, not only do these come to us now from America, but it was in that country that they all sprang into existence, with many brothers and sisters like themselves. I shall, no doubt, be answered that it was to that country that they all owed their birth, because American labour is so dear, and, consequently, some means must be found to economise it. You might imagine from this there was in America a national evil—dear labour—and that machinery had to be devised to overcome its ill effects. But do high wages necessarily mean large selling prices of manufactured goods? What foremen in this room, wishing to turn out articles well and cheaply, would prefer employing an ignorant Indian labourer at say twopence a day wages, instead of an English mechanic, with his knowledge of tools, at six shillings a day. So, in the same way, a highly paid American workman may, with his most ingenious labour-saving machinery, undersell the English in their own market. One of the things, therefore, which England requires, in order to regain her old commercial supremacy, is smaller cost of production of manufactured articles, a condition of things which, I think, you see, is not at all incompatible with higher wages.

In my British Association lecture to the workmen of Sheffield, this year, I have experimentally shown how an enormous economy can be effected in the consumption of coal, and, consequently, in the cost of generating power, and in the working of the metals, as well as in the expense of warming and lighting your buildings, by the employment of very large steam-engines and of natural sources of power, such as streams and waterfalls, and by conveying, through the agency of electricity, this power to the distant places where it was required to be used. For water power, if sufficiently far away from a town, is often worth little or nothing, since the cost of conveying the work done on the spot over the hilly country to the markets more than compensates for the economy of using water instead of steam; but the waterfall, if utilised for transmitting power into the towns by electric currents, becomes much more economical than burning coal. Again, as I explained to my audience, work done by distributed power from a very large steam-engine, would be much cheaper than using a number of small steam engines, if only the power could be distributed without the great waste which always accompanies the friction of shafting, leather-belts, tooth-wheels, &c. Now, if by means of what is called a dynamo-electric machine, we convert the work done by the one large steam-engine into electricity on the spot, and convey, by means of wires, this electric current to different points, and there, with dynamo machines worked backwards, we re-convert it into motive power, then the loss of energy by friction, &c., can, with the special form of working I explained, be reduced to something like thirty per cent.

As a small illustration of what I mean, I will show you the following experiment:—When I turn the handle of this machine, my muscular energy is converted into electricity; the food that I have eaten is burnt up in my body, and its equivalent—a current of electricity—is produced. This electric current, by means of the copper wires before you, is conveyed across the hall to that other machine, similar to the one I have here. In that distant machine, the electric current is converted back again into mechanical motion, and the work given out there can be practically made use of—for turning, for example, that sewing machine.

In the same way, but on a much larger scale, we ground knives on the platform of the Albert-hall, Sheffield, turned a lathe, sawed thick planks, electro-plated, and lighted the building, the power for doing this being all supplied by a steam-engine a quarter of a mile away. Coal was put into the furnace of the steam-engine at one end of the long copper wires, and work was given out at the other ends of the wires in the Albert-hall.

But the importance of this principle of the electric transmission of energy, like that of many other simple principles, while grasped by foreign engineers, is almost unknown to the British public. Last year, in order to gain the advantage of ploughing by steam, while at the same time to avoid the disadvantage of pulling a heavy steam-engine into rough fields, two French engineers, MM. Chrétien and Felix, ploughed by electricity. A plough was used having two sets of shears, so that it could be used going forwards or backwards without turning. This plough was pulled across the field, first one way and then the other, by dynamo-electric machines, stationed one on each side of the field. These dynamo-electric machines were driven alternately by an electric current, conveyed to them by wires coming from a third dynamo-electric machine on the hard road some hundreds of yards away, and to which motion was given by a steam-engine placed beside it. A photograph, taken on the spot, of the plough and one of the dynamo machines, I now project on the screen. We will next look at a second photograph of a drawing of M. Chrétien's electric crane for unloading boats. This also has been successfully employed for several months in the harbour of Sermaize, France, and it is considered that a saving of about thirty per cent. has been effected in the expense formerly incurred for unloading the sugar barrels out of the boats.

When one of our leading telegraph engineers, Dr. Siemens, has urged so strongly the economy of this electric transmission of power, it may appear inconsistent for me to say that the British public do not realise in the least the value of this new principle, and needless for us to fear that their conservatism will throw considerable obstacles in the way of its general adoption; but then we must remember that Dr. Siemens is a German, and was probably educated in a German Polytechnicon, or in some institution realising the value of technical education, and affording the means for imparting it.

At Sheffield it was the economy of utilising the present wasted natural sources of power that exist in our mountain streams that I urged on my large audience; to-night it is the utilisation of even a still more important dormant natural source of power—man's brain—that demands our close attention.

It must sometimes have puzzled you why a successful professional man, one who has no manual skill, no strength of limb, earns, by his work, so much money, and what is higher, so much fame. It must sometimes have struck you as, at the very least, rather hard that while you are toiling from morning to night, day after day, to gain only enough to live on, another, by the mere efforts of his thought, amasses a fortune. But you, no doubt, regard it as quite fair that a skilled mechanic should receive higher wages than a navvy. For you say that although he has eyes and arms, like yourself, and is, perhaps, the stronger of the two, still you can use your powers with a skill of which he knows nothing. Now, just as he has muscular strength, which, when cultivated, means wealth to himself and his country, so you have brain power, which only reguires education to fit it to do useful work. But you will say, am I not forgetting you have all been to school, and have received an education at least as good as is given in the Board schools. Consider, however, what is taught in these schools where masses have to be educated. Is there time to teach reflection, to foster the reasoning power? Is there that training

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given you which should make you unwilling to follow any special routine method in your trade, unless you are convinced it cannot be improved on? And can you expect it to be otherwise, when the boys and girls leave at 12 or 13 years old, when the main object of the teacher, who is paid by results, is to cram the young until they are heavy enough to drop through the examining machine, when occasionally the teaching is necessarily confined to the three R's, solely because the Government inspector finds that other subjects are—well, a little beyond his limited attainments. Again, what is the feeling boys and girls have at the national schools? If they succeed in their lessons, they look forward to becoming pupil-teachers; but if prizes do not fall to their share, they feel that teaching is not for them, and fall back on a trade; but how very few, if any, ever look to their studies as a means of making them educated workmen, instead of mere copying machines.

The consequence is that, when a lad is first apprenticed, he is merely an errand boy, or fag; being fit, in fact, for little else. Subsequently he is posted in one of the departments of the manufactory, his instructor being the man under whom he works; but this man, having his own work to attend to, has not time to teach, and, even were it not so, he could only show the boy the manual operations.

When the piece of work on which the apprentice has been engaged is finished it has to pass the foreman of the department; generally a man who, through honesty, sobriety, and manipulative skill, has risen from the ranks of the workmen, and whose education has been of a character similar to those around him. The foreman's duties, of course, leave him no time—even if he were competent—to give instruction, and thus the lad goes on, probably working, quite mechanically, at only one small branch of his trade. In time he becomes a journeyman; he may become a foreman, to govern others. Thus the "rule of thumb"—viz., each man working as his shopmates do—proceeds, and thus ignorance of principle has been carried on from one generation to another. And things go on remaining very much as they are, merely because we have never seen them otherwise.

The man or woman, then, instead of becoming an agent far above any machine—in that there should be the possession of the reasoning power, which is a quality of no machine—frequently finds him or herself, mentally, infinitely inferior to Babbage's calculating engine; bodily, quite unable to work with the accuracy and speed of, say, an automatic lathe for turning gun-stocks; and, from having a knowledge of only one narrow department of one restricted industry, is quite at the mercy of the fluctuation of trade for the means of subsistence.

But, do not let it, for the moment, be thought that I am regretting the Education Act of 1870, or am, in the least, blaming the necessary course taken by the school boards, since nobody is more alive than they are themselves to the incompleteness of the present education of the English artisan. That may be seen from this year's report of the Educational Endowments Committee, in which it is recommended that the city parochial charities shall be employed for the establishment of technical schools, to be attended by boys and girls for the two years after leaving the existing schools, that is, during their fifteenth and sixteenth years. It is not necessary on the preseent occasion to refer to the suggested curiculum of such technical schools, beyond saying that it appears to be complete.

It ought to be tolerably clear to every man, that it is important for him to have a good knowledge of the fundamental principles that govern the processes employed in his own trade. For example, when it is remembered what great mechanical differences are produced in iron by the admixture of even small quantities of carbon and by varying the temperature of hardening and annealing, the steel manufacturer will see at once the importance of the study of chemistry to him. In these pieces of steel which I hold in my hand, and which are all quite soft now, the smallest amount of carbon is less than one-tenth per cent. and the largest amount only one-and-a-half per cent., but if I heat all three pieces red hot and plunge them into cold water, the first, you see, remains quite soft, while the second has become springy, but the third is glass-hard, so that it shivers to pieces when I try to bend it. But if I had kept them heated white hot for some time, I should have burnt out the carbon, removed the steely nature, and spoilt them. If, again, after heating the specimens of steel red hot, I had cooled them very slowly, they would, as you all know, have been found each of them quite soft as they were originally. Now, many of us believe steel is far better for our bridges than iron, but the fact that such very slight differences in the chemical composition and the mode of cooling change so marvellously the mechanical strength without materially altering the weight or the general external appearance of the material, renders any system of testing the quality of the completed girders a difficult problem, and so while on the one hand we are still chary of using steel for bridge purposes, on the other hand the chief manufacturers and chemists are closely turning their attention to the difficult problem of producing steel in large quantities of identically the same chemical and mechanical quality throughout.

So, in the same way, a man engaged in telegraphy, or in any of the various trades connected with electricity, understands the importance to himself of a knowledge of electricity, for he has such facts constantly forced on him as that the difference of the hundredth of an inch in the position of a wire means the difference between a telegraph line in good working order and a total interruption. For example, this electro-magnet which we have on the table has now the power of holding up masses of nails, because an electric current is flowing round its two arms, but if I make a breach in the wire, and keep the two ends separated by even an exceedingly small distance, or if I even press the ends together, leaving, however, a bit of paper or some dirt between them, the electric current is so much weakened that the electro-magnet, as you see, has practically quite lost its power.

Or, again, such facts that metals expand when heated, as you see does this brass ball, so that it will not pass through the brass ring it slipped through when cold, are of importance to every wheelwright, to every caster in metals, &c.

But something more than mere special knowledge is of importance to each man, for the object of education is to develop the mental powers; the acquisition of knowledge I regard as of but quite a secondary importance. Let a man but acquire the art of learning one subject properly, and the groundwork of his education is to a great extent completed, since he will naturally afterwards be always seeking for knowledge from books, from teachers, from nature, in all those branches which at any time may be of importance to him.

It is of much importance that a correct notion of the real aim of education should be impressed on you to-night, when we are here to inaugurate the commencement of that wide scheme of technical education which the City and Guilds of London have, after mature deliberation, generously seen fit now to enter on. In the future, we hope to have special classes for a variety

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of technical subjects, and we shall look to you, guided by your own wants, to choose for us, to a great extent, what those subjects shall be; but, just for the present, we must be contented with only a few branches of technical education. Do not, however, run away with the mistaken notion that because I commence my first course of lectures on Monday next, in this building, on "Some of the Practical Applications of Electricity and Magnetism," that, therefore, if you are a watchmaker, or if you are a boiler-fitter, or if you are a coach-builder, you can have no concern with what will be taught. Do not say I shall never put up an electric bell; and, as for electric lights, why, in these hard times, I have hardly money enough to pay for tallow candles. If I were merely going to explain to you how an electric bell was made, and how it could be fitted up in the cheapest, and, commercially, best way; or if, again, in my lectures after Christmas, on "The Elementary Principles of Mechanics, as exemplified in our Clocks and Watches," I was merely going to tell you more dodgey ways of making cheaper watches; you might well say, if your particular trade was not concerned, "That's no good to me," and stay away. But when I tell you that, from the wide range of technical physical subjects from which the choice had to be made, electricity was selected to start with because it was a subject that had been so prominently before you of late, and the mechanical science of watches has been advertised to follow it, because a watch is a machine you nearly all of you possess, and can, therefore, examine for yourselves; and when I assure you that the fundamental truths that will be elucidated by experiments from these branches of inquiry will be of no less importance in the advancement of carpentry, printing, and turning than for improvements in electro-plating, watch-making, and the allied trades, you will see that coming to these lectures is a duty you owe to yourselves and to your country, and you will conclude, I hope, very many of you, that "since the City is generous enough to offer its money to help my education, I have ambition enough to come and learn."

I have said that the main object of education is the mental training which it ensures, and, as a proof of how very much more important this is than any mere accumulation of facts, may be seen from so many inventions having been made by minds which, although educated, had but a small knowledge of the special details of the science to which the invention belonged. Take, for example, the Bell's telephone; it was not any very extensive acquaintance with electrical apparatus that enabled Prof. Bell to invent this apparatus. Nor, again, was it a wide knowledge of the laws of acoustics that led Mr. Edison to successfully devise the first practical talking machine, the phonograph. And, thirdly, it was not any special knowledge of telegraphy that led Mr. Cowper to invent his "writing-telegraphy," and similarly with several other discoveries.

We may say that the invention of the Bell's telephone depended on the inventor, during his investigations of the experimental methods of determining the natural pitch of vowel sounds, seeing that magneto-electricity (that is, the generation of an electric current by the motion of a magnet near a coil of wire) realised, as Sir William Thomson puts it, "the mathematical conception that, if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of its current must vary continuously, and, as nearly as may be, in simple proportion to the velocity of a particle of air engaged in constituting the sound."

Magneto-electricity, as you no doubt all know, was discovered by Faraday, and is one of the most beautiful examples of the importance of studying elementary principles. Faraday was not a student at a university, spending money and time in learning the conventional accomplishments of a gentleman, but he was the son of a blacksmith who had, by hard work, to earn his own living. I have no time now, I wish I had, to tell you about the life of that one of England's heroes who spent it in fighting against and vanquishing scientific difficulties in order that the world might add to its possessions a new and unknown land of scientific discoveries. But I will say just one word about this discovery of magneto-electricity, since on it depends all the electric lighting of the present day, and all the electric transmission of power—that vital question of the future.

Faraday knew that motion could produce electricity with the ordinary glass electrical machine, and that the electricity so produced could, in its turn, set up motion, as in the pith ball telegraph worked by Sir Francis Ronalds. He knew that difference of temperature could produce an electric current, and the electric current could in its turn produce heat, or difference of temperature. Consequently Faraday felt sure that, since an electric current can, as you have seen, produce a magnet, a magnet must, in some way, be able to create an electric current. But his attempts were baffled time after time; failure, failure only was the result, yet buoyed up with hope, still persevering with that dogged earnestness which is the characteristic of an Englishman, he at length arrived at this all-important discovery—to produce a current with a magnet it is no use placing the magnet this way or that way relatively to the coil, but you must have *motion* of the one relatively to the other.

Here we have a vertical copper wire, up or down which we can send an electric current, produced by a battery outside the room. Behind the wire there is a magnet, suspended on a horizontal axis, so that it can turn in a vertical plane. The magnet is so arranged, that usually it stands upright, but if I send a current upwards, you observe this end turns to your left, while if I reverse the direction of the current the same end now turns to your right, the magnet in both cases placing itself at right angles to the wire.

Such an arrangement then is a detector of a current, but it is rather a rough one, and only indicates the presence and direction of large currents. But this other instrument, in which the wire goes many times round the suspended needle, is more sensitive, and as the deflection of the magnet is indicated by the motion of a beam of light reflected from a small piece of looking glass stuck on the magnet, the presence of very small currents may be detected. To the two ends of the wire forming the current-detector are attached the two ends of the wire forming this coil. The spot of light is now in the centre of the scale, indicating the magnet is undeflected, or that no electric current is passing; but if I rapidly move towards the coil this magnet which I hold in my hand, the spot of light is deflected to the left, and then comes back to the zero position, indicating that an instantaneous electric current was set up in one direction. Now, if I rapidly remove the magnet I have in my hand, you observe that the spot of light swings to the right and then comes back to zero, indicating an instantaneous electric current in the opposite direction.

When Faraday first made this discovery in 1831, I have no doubt many people thought it a very pretty scientific experiment, but not likely to be of any practical use. Yet to what a host of practical purposes has it been applied during the last forty years. We now see that the invention of the galvanic battery, such as we are using for producing the electric light in this hall, is beginning to sink in importance before magneto-electric induction; for how do we get those strong currents to produce the electric lights of the present day on the Thames Embankment, Waterloo

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Bridge, the British Museum, or nearer still, in Aldersgate station? By magneto-electric induction. How do we get these sparks with this Ruhmkoff's coil which enables us to imitate lightning on a small scale, and so to devise by experiment lightning protectors for our telegraph lines? By magneto-electric induction. Magneto-electric induction is used not only in the Bell's telephone (one of which you now hear on this table giving out the ticking of that clock by the aid of Hughes' microphone, and another of which you see employed with this Hughes induction balance, by means of which two grains of gold can be detected in a pound of silver, solely by the slight electrical change so small an admixture of gold produces throughout the whole mass), not only, I say, is Faraday's principle of magneto-electric induction employed in all these wonders, but it is made use of in the Edison's loud-speaking telephone which you now all hear telling you the words spoken to it by a man in a house in Tabernacle Row.

But, besides magneto-electric induction, Mr. Edison employs two other most ingenious principles in order to fulfil the necessary condition of every instrument used for electrically transmitting human speech, viz., that the strength of the electric current must be nearly proportional to the velocity of the particle of air engaged in constituting the sound. The first of these principles, discovered by him in 1872, is, that the passage of electricity, from one body to another resting on it, diminishes, in certain cases, the friction between them, and allows slipping to take place more easily if they are pulled one over the other. For example, if I am pressing a piece of platinum attached to the zinc pole of a battery, as in the figure, on to a piece of paper moistened with a dilute solution of hydrogen disodic phosphate, and attached to the copper pole of the battery, then if a pulling force be applied to the paper, a little less than that necessary to make it slip, it will be found that slipping will take place whenever the key is pressed down, so that the electric current is allowed to flow, and the paper will stop again each time the circuit is broken, so that the current is stopped. Already this principle has enabled Mr. Edison to convert his motograph or telegraph-receiving instrument without electro-magnets, and, it may possibly be found to have some connection with the comparative inefficiency of railway brakes when skidding takes place, that is when the rotation of the wheels is entirely stopped. But most important of all, Mr. Edison, by means of it, was enabled to devise his "loud speaking telephone," when the Bell Telephone Company would not allow him to make use of theirs. Inside this instrument there is a cylinder of compressed chalk, A in a figure, moistened with the liquid I have already referred to. C is pressed on to the chalk cylinder, so that when the chalk cylinder is rotated, C is, by friction, pulled a little onwards, and the diaphragm is stretched. If, now, an electric current, coming from the distant station, passes from the strip, C, to the revolving chalk cylinder, A, the friction is lessened, and the diaphragm springs back, and thus swingings of the diaphgram are set up exactly in time with the alterations in the strength of the electric current. But how does Mr. Edison make these variations of strength of the current time with the sound waves emitted from the speaker's mouth? By utilising another very pretty principle—that carbon opposes less resistance to the passage of an electric current, becomes, so to say, more porous to electricity, if you squeeze it. A galvanic battery sends a current through a piece of pressed carbon at the speaking end, and the sound waves emitted by the speaker's voice strikes this carbon, and press it more or less, making the current stronger or weaker.

Next, let me draw your attention to the American Stock Printing Telegraph, of which we have specimens in this hall receiving and printing messages sent from a house in Tabernacle Row. This instrument, in that the paper is started running, the message is printed, and the paper stopped again when the message is finished, all by electric currents coming from the distant station, and without any control of any kind at the receiving end, may be looked upon as wonderful, even for an American invention.

Look again at Cowper's writing telegraph, some specimens of the production of which are now handed round the room. It is a well known principle that any motion along a plane may be regarded as the result of two motions at right angles to one another; any motion of a fly, for example, crawling along a wall, is so much movement up or down, combined with so much movement sideways. With these two levers working at right angles to one another, and conjointly moving a pencil, I can write what I like, or, if properly controlled for me by these cams, they will write definite letters, in this case, "W. T.," Mr. Cowper's initials. This idea is employed in defining the position of a place on the earth's surface by its latitude and longitude, it constitutes the whole of the science called *analytical goemetry*, which has been of so much service in all branches of modern scientific advance. And yet it does not seem to have occurred to telegraph engineers that all ordinary writing can be compounded of two motions at right angles to the two edges of the paper, and, by well-known electric principles, can be exactly reproduced and compounded at a distance, producing a facsimile at one end of the line of what simultaneously is written at the other. Technical education being what it is, it is not surprising that this electrical invention should have been made by a mechanical engineer and not by an electrician.

We might, did time only allow, go on multiplying indefinitely examples to prove that a *general* knowledge of elementary principles is of the greatest importance to every man, whatever be his trade. George Stephenson, but a coal miner, and yet the practical inventor of the present locomotive engine, understood that fully. No Institution for the Advancement of Technical Education was founded for him, no City companies lent him a helping hand, and yet he set himself to study the principles of mechanics when he had only just succeeded, with great difficulty, from his absence of leisure and instruction, in teaching himself to read and write, as he sat by the engine fire. The account of his experiments to discover a form of miner's safety lamp is a living exemplification of the rule attributed to Bacon, but, in reality, given long before by the painter Leonardo da Vinci:—"Begin with observations, go on with experiments, and, supported by both, try to find a law and a cause." Starting with his own idea that, in order to prevent fire-damp exploding, it was necessary that the gas should pass through the lamp at a certain velocity, Stephenson arrived, after many experiments, at the all-important result, discovered quite independently by Sir Humphrey Davy, that wire gauze, if the meshes are of sufficient fineness, cuts, as you see, a mass of gas into two portions, one of which can be ignited without the other catching fire or exploding.

And, realising so fully as he did the advantages of education, it is not to be wondered at that he strained every nerve to have his son Robert well taught, and even sent him to Edinburgh University, where, in six months, he is said to have acquired as much knowledge as takes many ordinary students three years to learn. And why to Edinburgh University, and not to some nearer English college? Because, at that time,

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there was no institution where the means of a man like George Stephenson, only one step removed in position from that of an ordinary miner, could obtain even a decent scientific education.

And what has been the result of this cheap and general Scotch education spread over many years? Why, that we now see so many posts at home and abroad held by Scotchmen, just as we find a considerable portion of the more important positions in our manufactures occupied by young Germans solely on account of the scientific training they have received.

What were the feelings Professor Bell had when in England. He wrote to America:—"If you want to know why inventors are more numerous in America than they are in England, come and live for six months in England. If you wish to know what it is to be brimful of ideas, and yet to be unable to have them executed, come to England. Masters, instead of encouraging invention, do all they can to put a stop to it, by charging the most exorbitant prices for experimental work, avowedly because they don't want such kind of work, because it gives, they say, more trouble than it is worth," and much more of the same nature.

Now granted, if you like, that this is much exaggerated, granted, even if you wish, that it arose from national prejudice, still we must remember that Bell himself was an Englishman, and the inventor of one of the most wonderful instruments of modern times. Also, we must not forget that George Stephenson's attempt to survey the route for the Liverpool and Lancashire Railway led to his being frequently stoned by the inhabitants of the property, who have since most largely benefited from his work; and that Sir Francis Ronalds' letter to the Secretary of the English Admiralty, in 1816, describing the electric telegraph that Sir Francis has constructed, and successfully worked, led to an answer, splendidly calculated to foster invention, viz.—"Mr. Barrow presents his compliments to Mr. Ronalds, and acquaints him, with reference to his note of the 3rd instant, that telegraphs of any kind are wholly unnecessary, and that no other than the one now in use" (that is the semaphore) "will be adopted."

If England is, then, so lamentably deficient in technical education, how is it that English engineers, English workmen, have hitherto been considered first in the world? Because we started earliest in the race, because we had an abundant supply of coal and iron, and, lastly, because we had an indomitable energy; but Dr. Lyon Playfair, some years ago, asked this question, and the present depression in trade leads me to ask it again now:—"Do you sincerely think that the country can continue in a career of prosperity, when she is the only leading State in Europe that is neglecting the higher education of the working classes, and of those men above them whose duty it is to superintend their labour? It is a truth incapable of being gainsaid, that science must be joined to practice in the advancing competition of the world, in order that a nation may retain the strength and energy of manhood; for States, like individuals, fall into decrepitude and decay." Dr. Lyon Playfair has been answered; answered sooner, and in a more decided manner, than even he could have feared; and that reply is, No! our country has, indeed, not continued in its former state of prosperity. Years ago France, Germany, and, above all, Switzerland, set themselves the same question; but instead of waiting, like ourselves, for time to give the sad response, they foresaw it, and, by fostering technical education, have absorbed into their country some of the industries of the world. The city and canton of Zurich, having once grasped that their system of national education was defective in modern practical science, vied with each other in providing funds for the complete equipment and support of a technical university. They did not, as Mr. Scott Russell tells us, ask themselves "what is the smallest and least costly scale on which we can begin to make good a few technical deficiencies?" but they asked themselves that other question, "what is there in the science, the philosophy, the learning, the art, and the practical skill of modern times, which can be learnt and taught, but for which there is no adequate provision already made for teaching to our students in the universities of our land?"

And yet another nation, small and apart from the world, a people like the Swiss, dwelling in a mountainous country, and like them too dearly loving their pine-clad hills—the Japanese—have set us an example that our ambition should lead us to emulate. Much have we heard of Japanese art, much have we seen of Japanese lacquer, Japanese fans, but only a few of us are acquainted with the Japanese modern technical education. Ten years ago a feudal country, tyrannised over by barons, with power of life and death in their hands, distracted by the conflict between the rightful sovereign and their hereditary military usurper, that nation whom we regarded as barbarous, that nation of whose manners we were comparatively ignorant, whose very modes of thought are so different from our own that we can be hardly said to understand them now, that people had but three years emerged from a state of almost slavery, when up grew, in its very midst, a technical college, with its staff of carefully chosen English professors, with its laboratories, class-rooms, museums, libraries, and workshops, costing Japan, a poor country be it remembered, at least twelve thousand pounds a year to support, and many many thousands to build. And to enter and study at this college, neither money, nor position, nor any qualification is necessary but ability and desire to study; so that working at the lathe, or conning over their books in the class-room, or experimenting in the laboratory, may now be seen, side by side, the young noble and the young artisan.

An example to emulate did I say? The City companies have given us the opportunity, let us show that we appreciate it. They do not propose merely to teach each man his trade or business, for that he can best learn in the workshop or counting-house, nor have they any idea of merely grounding you in elementary arithmetic, since that you can learn at school; they do not start by building handsome edifices, although they have subscribed many thousands for erecting in London a large central technical college, but what they have done is to henceforth put on one side more than fifteen thousand a year of their own money to give you from now that education which will enable you to commence doing what George Stephenson, in these words, half a century ago, urged on you:—"Learn for yourselves, think for yourselves, make yourselves masters of principles, persevere, be industrious, and then there will be no fear for you."

HICKLEY'S PATENT AUTOMATIC ELECTRIC LAMP.

THE distinguishing features in this lamp are its extreme simplicity, the ease with which the carbons are replaced by fresh ones when required, and the manner in which the length of the arc can be adjusted to suit the number of lamps to be put into one circuit; also the cheapness at which it is produced is no small feature in its favour.

Fig. 1 is a plan and fig. 2 a side elevation of the lamp. L is a lever which works between two

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screws in the frame F F. At one end of this lever is fixed an iron armature over the electro-magnet M, at the other end is an arbor on which are fixed a ratchet wheel C and a disc of carbon C, the latter being about four inches diameter and one inch thick. The adjusting screws are so placed upon the frame F F as to prevent the armature end of lever L rising too high or the disc at the other end falling too low; this screw regulates the length of arc, for if the disc C is allowed to rise and fall a ¼ inch the arc will be ¼ inch long, or more or less as required. The frame carries an insulated terminal T, which is connected to one end of electro-magnet, the other end of which is attached to the frame F F itself. At the end of the frame is a pawl P for the

Fig.1

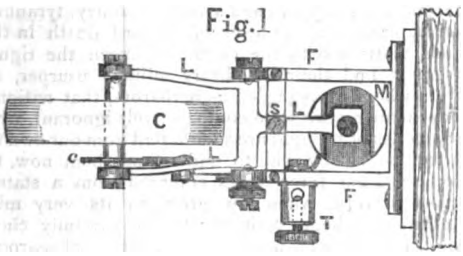
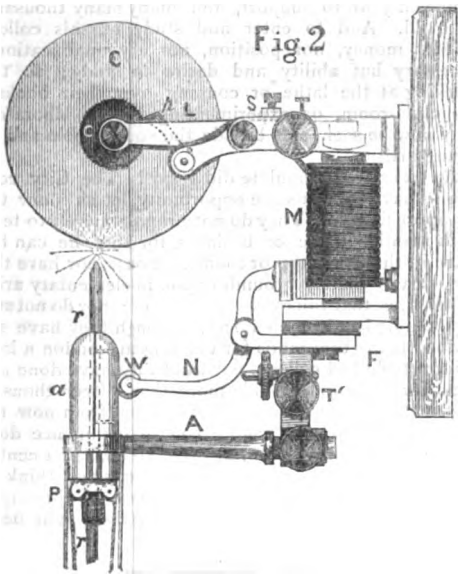


Fig.2



purpose of turning the disc of carbon every time the latter falls and rises. At the lower end of the frame under the magnet is an arm A (fig. 2) carrying a cone piece cut vertically in two pieces, one piece coming off inwards and kept in its place by steady pins; a conical hole, larger at the bottom than at the top, runs through this cone, through which the rod of carbon R passes, the latter being raised by pulleys P with a cord and weight (not shown). The hole through the cone not being large enough for the carbon, the loose half becomes forced away; but this latter is pressed by the wheel W (when a current is passing) so as to prevent the carbon rising. The other end of the lever N has an iron armature, which is attracted by the lower end of the electro-magnet M. The arm A carries a terminal T'.

The action of the lamp is as follows:—The ball or disc of carbon C falls by its own weight as low as the adjusting screw S will allow, whilst the lower carbon is raised by the weight until it touches the disc; the current then immediately passes from terminal T on top of frame through the coil of the electro-magnet to the frame and thence to the disc of carbon on to terminal T'. The iron armature on the locking lever at the bottom of the coil and the armature on the top lever L are both attracted by the electro-magnet, the lower one rather sooner than the top one, being nearer the pole of the magnet. The lower carbon is by this means locked or prevented from rising any higher, the disc rising until the armature nearly touches the electro-magnet, thereby producing the arc. When the lower carbon shortens so as to weaken the electro-magnet, and thus to lengthen the arc, the disc falls as low as the adjusting screw will allow, whilst the lower carbon rises until it touches the disc, or until the arc is shortened sufficiently to cause the magnet to again raise the disc, when the current again passes until more of the lower carbon is required, when the same action takes place again; but so rapid is the action that it is scarcely visible. At each movement the disc is turned one or more teeth, thereby exposing a fresh surface to the action of the current.

We had the pleasure of seeing Mr. Hickley experimenting with two of these lamps in one circuit, and, although they were but early specimens, and necessarily not quite perfect in finish, they burnt with considerable steadiness.

THE ELECTRIC MOTOR OF M. MARCEL DEPREZ.

By E. HOSPITALIER.

THE question of electric motors, as of steam motors, divides itself into two perfectly distinct parts: 1st, the production of electricity; 2nd, the utilisation of electricity for the production of motive power. It is towards the second part of the question that the apparatus of M. Marcel Deprez has made great progress, and it is this point which deserves close attention.

We shall first describe the motor, it will then be easier to point out the advantages which it possesses.

The apparatus is composed of a compound horse-shoe magnet formed of eight magnets; these magnets have a much greater power than those found in a single piece of a similar total weight of metal. Between the poles of this magnet is placed a "Siemens' armature," the axis of which is parallel to the arms of the magnet. This armature is a cylinder of soft iron, with two longitudinal grooves, in which is wound insulated wire, the two extremities of the wire are connected to a commutator against which rub two wire brushes, as in the Gramme machine. The *rôle* of the commutator is to change the direction of the current at each half turn.

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The current which traverses the wire of the armature B produces in the latter two poles of great length which change their condition at the moment when they commence to pass before the poles of the magnet. The poles of the same name repel one another, those of opposite names attract, so that it is easy to see that the armature obtains a movement of rotation which depends upon the direction of the current which traverses it. The commutator brushes are mounted on a support which can be turned around the axis of the armature, this enables the range of the apparatus to be easily adjusted, so that the speed can be changed within wide limits.

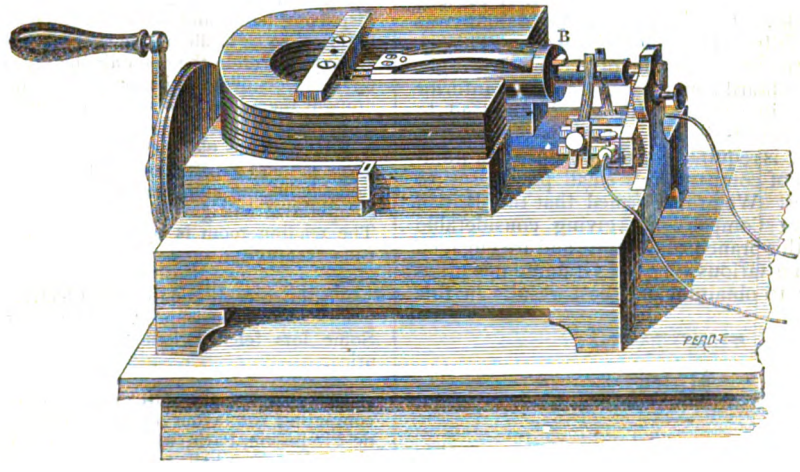
In the small model shown by the fig., which is drawn to one-fourth scale, the magnet is composed of eight plates weighing 1,700 grammes, the armature weighs 400 grammes, and the whole apparatus about 4 kilogrammes.

The normal velocity of the armature is 3,000 turns per minute, which corresponds to 100 charges of the current per second in the armature B. The pulley, which is seen to the left of the fig., makes 100 turns per minute; the pulley can be connected by a simple gut-cord to any machine the apparatus may be required to turn, such as sewing machines, &c. To this apparatus M. Deprez has added a peculiar arrangement which constitutes an excellent regulator of velocity. If the rotation tends to become rapid, in consequence of an increase in the electric current or by a diminution in the work to be done, a little spring connected at one end with one end of the wire on the armature, and which presses against the commutator so as to make connection with the latter, flies out by centrifugal force and breaks the contact. The circuit being thus interrupted remains so until the speed of rotation of the armature diminishes and allows the spring again to make contact. This arrangement is so sensitive that the speed of the apparatus can be preserved within a limit of $\frac{1}{100}$th of the normal velocity.

We give below some results of some experiments made at the workshops of the late M. Ruhmkorff, with the kind permission of M. J. Carpentier, the constructor of the apparatus; experiments which show the remarkable power of this motor. In these experiments the source of electricity was a Bunsen battery of the Ruhmkorff model, the cells being joined up for intensity. The figures in column 2 are those obtained with the small model just referred to, those in column 3 are the results obtained with a similar machine of larger dimensions. The work is expressed in kilogrammes.

Number of Ruhmkorff elements joined up for intensity. (1.)	Work developed by the small Deprez motor. (2.)	Work developed by the large Deprez motor. (3.)
1	0·27	0·40
2	0·57	0·70
3	0·87	1·10
4	1·10	1·50
5	,,	1·90
6	,,	2·30
7	,,	2·70

These results differ greatly from those obtained with the electric motors experimented on in 1855



by M. Becquerel. The results are so satisfactory that we will state to what they are due:

1st. The replacement of oscillating movements by rotatory ones, which enables greater speed to be obtained.

2nd. The longitudinal arrangement of the armature replacing the transverse position. This change, which constitutes the true perfection carried out in the Siemens' apparatus, utilises all the power of the magnet and renders the motor much lighter with equal power.

3rd. The easy adjustment of the position of the contact brushes, which enables the best position for maximum power to be obtained.

4th. The regulator of velocity by centrifugal force prevents the machine from overrunning itself.

Let us add in conclusion that the motor is *reversible*, that is to say, if we turn the handle shown

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in the fig. the machine will generate a current the force of which is equal to three Bunsen elements with the small model. From this point of view it will be very useful in laboratories or places where battery power is only required for a short time. It is sufficient to turn the handle in order to produce a current of electricity sufficiently powerful to repeat most of the experiments with dynamic electricity, such as chemical effects, calorific effects, electro-magnetism, induction, &c. Considered as an electric motor, the apparatus of M. Marcel Deprez will be susceptible of a great number of applications when electricity comes to be laid on for domestic purposes, or when an economical battery is discovered, which latter, however, seems at present hardly probable.—*La Nature.*

SHIP LIGHTING BY ELECTRICITY.

DURING the recent trial trip of the new steel ship *Mendoza*, built for the Pacific Steam Navigation Company by Messrs. Napier and Sons, of Glasgow, an interesting trial of the electric light was made in the saloon of that vessel. The apparatus was fitted temporarily on board, and consisted of a Gramme machine and Serrin lamp, which for some time past have been used to illuminate a portion of Messrs. Napier's works. It is stated that the saloon was very successfully lighted by this means. This is, we believe, the first example of the electric light being used on board a merchant steamer for interior lighting, and its success will, no doubt, lead to further experiments in the same direction being made. What is required for the purpose is a number of lights of comparatively small power, say 50 to 100 candles. We are informed that the British Electric Light Company are giving considerable attention to this branch of lighting, and are engaged in constructing various types of Gramme machines with a view to obtaining the best results in this direction.

Notes.

THE ELECTRIC LIGHT.—M. Berly, of the Société Jablochkoff, has recently arranged with Mr. Nicoll, of Regent Street, for four lights of that system in addition to the Serrin lamp previously used in the establishment of that gentleman, the whole to be worked from an Otto gas-engine. Messrs. Crocker and Sons, of Friday Street, are more and more pleased with the twenty lights they have established on their premises. Two other large firms, whose names we may not at present mention, are also about following the example of the Messrs. Crocker. In London the light has not come into use for the inside lighting of theatres, possibly on account of the cheapness of gas in this country; but at the Bellecourt Theatre, Lyons, there are 52 Jablochkoff lights—8 in the central chandelier, 4 in the auditorium proper, and 12 on the stage; the remainder in the corridor, tower, and basement. These are all worked from three Gramme batteries, driven by two 25-horse power engines. The Chatelaine, Paris, has 16 lights—4 outside, 8 in the auditorium, and 4 on the stage. The Café Concert La Scala, has also 16 lights, and the Grand Theatre, San Francisco, is likewise lit by Jablochkoff candles. In Persia the Shah has installed the same system, and inaugurated the lighting by himself closing the circuit.

DIVIDING THE ELECTRIC LIGHT.—In the *Telegraphic Journal* for July 15th we illustrated the plan of Messrs. Molera and Cebrian for distributing the electric light by means of lenses and reflectors. The following facts constitute some late information on the subject, and on the result of a recent experiment:—"The fountain light used was a 4,000-candle electric light, enclosed in a chamber, on one side of which was a 24-inch Fresnel lens, from which beams are projected in parallel lines. The whole or any number of these lines, or rays of light, may be collected on a mirror or reflecting surface of any kind, and distributed in any greater or less intensity through secondary lenses without additional loss. In the experiment hardly one-half of the main light was collected, but it was divided into 16 separate lights, equal to 80 candles each. The secondary lenses were of small size, and situated in the ceiling, the light being thrown down. The quality of the light was equal to pure diffused daylight—in fact, several hundred shades of silk, arranged upon cards and placed side by side, could be distinguished as readily as by sunlight. Had it not been for the loss of light, occasioned by the size of the reflecting mirrors, we believe the light could have been subdivided to its fullest extent, and into at least 50 separate lights. The whole light from the main lamp can be divided and subdivided, and distributed down to a single ray even, at pleasure. The dispersing lenses and reflectors are arranged inside the building so as to illuminate every part without any obscure corners. In the open air the rays of light thrown upon objects over a mile away in the darkness of night brought them into view with startling distinctness."

THE Siemens electric light at the British Museum gives general satisfaction. There is little or no objectionable hissing now; but there are some readers who complain of a slight inconstancy in the illumination. The reading room is by its aid kept open till 7 p.m. each evening.

AT the recent sale of the Electric Lighting Company's effects the sums realised were ridiculously low. Some lots fetched less than $\frac{1}{4}$th of their ordinary price.

THE LONTIN AND SIEMENS ELECTRIC LIGHTS are competing for favour in a public display at the Palais de l'Industrie, Paris, where they are to be seen illuminating the same hall.

THE NEW FRENCH ATLANTIC CABLE has now been completed by the *Faraday* between Brest and St. Pierre; and the St. Pierre to Cape Cod section is now being laid.

BROOKE'S UNDERGROUND CONDUCTORS have been tried along a railway between Bruges and Ostend, Belgium. The tube is 1,200 feet long, 2 inches in diameter, and contains 21 conductors. The electricians of the Belgian Telegraphic Administration have found the insulation to be five hundred million Siemens' units per mile. The inductive capacity was only about one-thirteenth of that of ordinary Belgian submarine cables, and the proportion of specific inductive capacity, compared with that of gutta-percha, was much less. It is stated that inductive disturbances do not affect the Gower telephone when joined up in circuit with one of the wires, although the others in the same tube are busy working with the Hughes instrument; but as the Gower circuit would seem to be composed of a going

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and returning wire twisted together, this is hardly to be wondered at. Mr. Brookes has gone to Paris to submit his system to the French Telegraphic Administration. Our readers are probably aware that Brookes' system is also being tested at the Silvertown Works.

THE MICROPHONE FOR DEAF PERSONS was brought before the Société de Biologie by M. Paul Bert recently, but it did not work. M. Alf. Niaudet, however, informs us that M. d'Arsonval is about to show him the instrument, and he will let us hear the result.

THE NEW AMERICAN UNION TELEGRAPHIC COMPANY has formed an exclusive connection with the New French Cable Company; besides having a working agreement with the Dominion Telegraph Company of Canada. The latter company has reduced its tariff to 20 cents for 10 words, out of unfriendly rivalry to the Montreal Telegraphic Company.

A CHAMBRE SYNDICALE of Electricity has been established in Paris, and now numbers over 75 members.

THE AMICABLE DINNER of the Paris scientific press, which took place recently, inaugurates a custom which we should be glad to see adoped in London.

A NEW PHONOGRAPH.—Edison's phonograph, as now constructed, is in several important respects defective. For example, the time of recording the sound on the apparatus is proportioned to the size of the barrel. The necessity of wrapping the barrel with foil does not permit of the conservation of speech, and by reason of its flimsy character only allows of several repetitions. With a view of overcoming these drawbacks, a young French professor, M. Custane Gamard, has, we are told, constructed a modified instrument, in which the speech is impressed along a straight, instead of a curving, line. This apparatus consists of a horizontal plate, upon which a series of chariots can be placed; movement is given by means of a rack fixed to their lower part and gearing with a toothed wheel furnished with a crank. At the centre of each of the chariots is placed at will a little copper rule, to which is attached a light leaf of copper or silver. Above this system is mounted the vibrating plate, furnished with its probe or stylus. On speaking into this new phonograph on putting the first chariot in motion the voice engraves itself on the metal leaf; and it is only necessary to employ succeeding chariots in order to record the entire discourse. The second difficulty has also been overcome by M. Gamard, for the moveable rules to which the metal leaf is fixed can be detached from the chariots supporting them. To make them reproduce the sounds which have been registered on them, it suffices to replace them in the apparatus. The substitution of copper or silver leaf for tinfoil renders the matrix capable of preserving the speech for a long time, and giving many reproductions. The rigidity of these leaves prevents their employment in the American phonograph. M. Gamard's improvements are an advance towards the date when the Edison phonograph will cease to be a scientific curiosity, and become of some practical value.

THE CANTOR LECTURES.—The second course of these lectures will be on the "Manufacture of India Rubber and Gutta Percha," by Thomas Bolas, F.C.S.; and we observe that on the ordinary meeting for December 3rd, Dr. Sylvanus Thompson will discourse on "Apprenticeships Scientific and Unscientific."

PRIZE ESSAYS.—Among the subjects which are eligible for the next prize competition of the Institution of Civil Engineers, we observe the following: "The Relative Advantages of Steam, Heated Air, Gas, Water, and Electricity as the Motive-Power in Small Engines," and "The Employment of the Electric Current for the Transmission of Sound, and the Use of the Telephone for Practical Purposes."

TAMING HORSES BY ELECTRICITY.—The Paris Omnibus Company now administer electric shocks as a check upon restive and gibbing horses. The current is excited by a small Clarke induction machine, and is led by wires along the reins to the bit of the horse whose evil propensity is well-known, When the horse is stubborn or vicious, the driver presses a button in the apparatus beside him on the box, and closes the electric current. The instant the animal feels the mysterious sensation in his mouth, he is said to submit at once. The effect appears to be a simple numbness or uneasiness rather than actual pain, and is probably more humane than curb or whipping.

LE SOLEIL ELECTRIQUE.—Our French contemporary, *L'Electricité*, in a review of Lontin's electric lighting apparatus, exhibited at the Palais de l'Industrie, Paris, gives a description of an illuminating device termed an electric sun. It is formed of four carbon electrodes radiating from a common centre, but without touching there. Four separate currents are sent through these carbons. The first enters by the carbon A, and leaves by B; the second enters by A, and leaves by C; the third enters by C, and leaves by D; the fourth enters by A, and leaves by D; thus forming a spherical arc, and giving a complete circle of dazzling light from every point of view, resembling the solar disc itself.

THE ELECTRIC LIGHT UNDER WATER.—The German military have been trying submerged electric lights in the Rhine for detecting torpedoes moored under water. A transparent globe enclosing an electric lamp was sunk 60 metres below the surface, and by means of the current from a generator on shore it served to illuminate the surrounding water and bottom. For engineering surveys, and for attracting fish, these subaqueous lights may be of considerable use.

GOWER'S TELEPHONE has been adopted in Paris to connect the office of the *Temps* newspaper with the editor's home.

EDISON'S TELEPHONE has been adopted by the Paris *Figaro*, and seats for theatres may be secured at the *Figaro* office by telephone without the necessity of going to the theatre itself. Perhaps our own telephone companies will take the hint, and put themselves into telephonic communication with the leading theatres for this purpose. Edison's telephone will probably also be installed in the French Senate and Chamber of Deputies. During the ensuing session it is stated that the telephone is to be employed in reporting the parliamentary debates for our own *Times*, and the type-setter will be able to set them up as they are spoken to him, thereby saving the trouble of transcription from the short-hand report, and gaining some 40 minutes in point of time, that is, enabling the paper to publish some 40 minutes more of the proceedings; we are unable to understand, however, how type can be set up as rapidly as a speech can be delivered.

A LIQUID RHEOSTAT.—Mr. F. J. Smith describes in a recent number of *Nature* a simple pressure rheostat

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made by taking an elastic tube filled with a weak solution of salt in water, and subjecting it to the adjustible pressure of a screw at its middle. A current passing through the solution meets with resistance proportioned to the pressure of the screw. The tube can also be used as a telephone transmitter, by providing it with a diaphragm, which bears on the side of the tube like the screw under the impulses of the voice.

COPPER-COATED ZINCS in sulphate of copper batteries are a source of waste, which it is difficult to get rid of; but Herr Moser seems to have hit upon a good plan in hanging a strip of zinc a few centimetrers long below the zinc-plate proper. This has the effect of attracting the copper diffusing upward, and leaving a clear boundary between it and the zinc solution *above*.

A NOVEL THEORY OF SUN-LIGHT has been propounded by an American *savant* in that eminent scientific authority *The Buffalo Sunday Courier*. Says this latter-day Gamaliel:—"Thus sun-light and sun-heat are shown to resemble the light and heat which we are able to develop through the aid of our magnetic machines. The fact of the actual production of the intensest heat yet reached, through the agency of mere motion, opens up to us a new view of these great forces. As motion applied to our dynamo-electric machines is *changed* or *converted* into light and heat, so also may sun-light and sun-heat be the products of mere change, of simple conversion of force, instead of the products of a measureless and ceaseless destruction. The element out of which they are developed passes, as we may suppose, through all space without visible form or manifestation, as electricity through wires, and without visible means of transportation; as, for example, Prof. Loomis sent the magnetic current from kite to kite, flown from Virginia mountain tops, twenty miles apart. Moreover, as the 'carbon point' or the 'platinum coil' is the necessary resistance, the encountering of which developes the electric light out of our little electric current, so may this earth's atmosphere furnish the required resistance out of the encounter with which the great current of force from sun to earth, invisible while passing through vacant space, becomes manifest light and heat. The analogy, to say the least, is very striking. Science at the present time admits of four different explanations of the production of sun-light and sun-heat, viz.: (1) Combustion of cosmical substances falling into the sun; (2) arrest of motion of such cosmical substances; (3) contraction of the solar mass; (4) dissociation of compound bodies in the sun's substance. It will be observed that there is no recognition here of the two forms of light and heat; the sun is by all of them made the manufacturing place of light and heat, as well as the distributing reservoir, whence the whole solar system is supplied; not with the invisible, insensible, potential light and heat, *to be developed where required*, but with these actual forces."

MAICHÉ'S BATTERY.—In this form of cell the negative pole is of amalgamated zinc and the positive platinised gas carbon in lumps. The liquid is chlorhydrate of ammonia. The cell is constructed of a glass bowl with an ebonite cover, to which is fixed a gallery of porous glass traversed by an ebonite tube which supports a little porcelain cup. The gallery is filled with platinised carbon lumps. One of the fragments is fixed to a platinum wire, which is connected to a terminal on the ebonite cover. A second platinum wire from the other terminal on the ebonite makes contact with the mercury in the cup in which the zinc plate is dipped. The level of the solution of ammonia (15 grammes per litre) ought not to rise more than 2 centimetres above the bottom of the porous gallery containing the carbon.

TREATMENT OF HYDROCELE BY ELECTRICITY.—Dr. Rodolfi, who has successfully operated on many cases of hydrocele (water-tumour on the scrotum), attributes the disappearance of the liquid in them to the *mechanical* action of the current. His plan is to withdraw the liquid contained in the vaginal tunic, then introduce through the canula of the trocart a probe with a copper button 20 centimetres long, insulated save at its ends. This is connected to the negative pole of a battery of three Grenet or four Bunsen cells of medium size charged with bichromate of potash. The positive pole, furnished with a sponge dipped in water and pressed, is placed on the scrotum towards the cordon. The button of the probe is afterwards made to describe arcs of a circle so as to pass over all the internal face of the vaginal tunic. The operation lasts from six to ten minutes; the patient feels little pain.

ABSORPTION OF HYDROGEN BY NICKEL.—It has been shown by M. Raoult that porous nickel absorbs hydrogen when it is employed as the magnetic electrode in the decomposition of acidulated water.

GALVANIC OXIDATION OF GOLD.—In recent experiments on the decomposition of water, it was remarked that a wire of gold, used as the negative pole in sulphuric acid and traversed by the current, was gradually dissolved away. It was suggested by M. Chevreul that this effect might be due to the formation of persulphuric acid, and M. Berthelot has made some experiments to decide whether or not this is the case. He finds that nitric acid under the same conditions as the sulphuric also attacks the gold wire, precipitating in the process a violet coloured oxide of gold, which is held in suspension. On the other hand, potash or phosphoric acid does not attack the gold. The dissolution is not due to ozone, for oxygen charged with ozone dwells without action upon the gold in presence of water, either pure, or charged with sulphuric or nitric acid. Persulphuric acid (prepared by electrolysis) does not attack gold, even when it enclosed some quantity of oxygenated water. It follows, from these experiments, that the said attack on gold is only made under the influence of the galvanic current, and at the contact of the electrode and the electrolite.

NEW MODE OF EXCITING AN INDUCTION COIL.—Mr. W. Spottiswoode, LL.D., finds it a good plan to use the alternating currents of a De Meritens magneto-electric machine to excite an induction coil. In this arrangement the "make" and "break" currents in the primary are alternately in one direction and the other, hence the secondary discharge appears to be the same at both terminals. The advantages of the method are: first, the fact that as the machine effects its own make and break, both the contact breaker and the condenser of the induction-coil can be dispensed with; secondly, that the breaking of the primary, and consequently the delivery of the secondary currents is perfectly regular; thirdly, that the quantity of the currents in the secondary is very great. With a 20-inch coil by Apps a spark about seven inches in length, of the full thickness of an ordinary cedar pencil, has been obtained. But for a spark of thickness comparable at least with this and of two inches length, an ordinary 4-inch coil is sufficient. In vacuum tubes under this discharge the striæ are perfectly steady, as with a battery (Gassiot's or De la

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Rue's), and their brilliancy and configuration can be controlled by means of a shunt in the secondary circuit, formed by a column of glycerine and water, so as to diminish at will the amount of current flowing into the tube.

ELECTROMOTIVE FORCE OF WATER JETS.—M. Elster finds that, contrary to the assertions of Herr Edlund, there is no electromotive force produced by the friction of two jets of water on each other. When, however, a jet of water is directed against a non-conductor the friction does produce electromotive force. Hence the electromotive force produced by the flow of water and other liquids through capillary tubes.

Two French officials have been engaged to organise the telegraphs of Bulgaria.

ELECTRICITY AND ANIMAL ORGANS.—According to M. Desplats, if we apply the two electrodes of a battery to the skin, the first phenomenon observed is one of sensitivity—the person operated on experiences a tingling sensation, which is converted into actual pain if the current be sufficiently strong; soon this sensation is accompanied by a more or less marked redness, indicative of increased activity of the circulation; and, finally, if the current be sufficiently intense and long-continued, the part acted on is disorganised, and a true burn is produced. The application of an electric current to the skin produces, therefore, two phenomena of a vital nature—sensibility and increased circulation, and one of a chemical character—disorganisation. It is probable, however, that the action of an electric current on the skin does not stop here, but that the secretion of the sudoriparous glands is modified, as well as the production of the pigment to which the colouration of different parts of the body is due. The disappearance of the frontal ephelides in pregnancy, after a few minutes' application of any kind of electric current, lends support to this view. If, instead of being applied to the skin, the current be made to traverse a muscle, a nerve, or a gland, it produces there, as on the skin, a sensitive impression, an increase of the circulation, and, at length, a chemical action. But, over and above this, it causes an exaggeration, or rather a modification, in the functional activity of the organ traversed; the muscle contracts, the gland secretes, and the nerve, which exhibits no apparent reaction proper, manifests the impression which it received through the medium of the organs to which it is distributed. No organ, therefore, escapes the action of electric currents, and all parts alike of the body may be modified by them.

ELECTRO-MEASUREMENT OF THE HARDNESS OF STEEL.—A new apparatus has been produced by Professor Wattenhofen, of Prague, for measuring the hardness of steel electro-magnetically. Its principle is that hardness of steel may be very correctly inferred from a numerical determination of its coercitive force. In its main features, his arrangement is as follows: From one end of a balance arm are suspended successively, in a brass holder, bars of the steels to be examined—those being as nearly as possible equal in weight. The other arm bends obliquely downward, and bears a constant weight. Motion of the beam causes a pointer to move radially over a scale, the movement being magnified by toothed wheels. One of the steel bars having been suspended, a magnetising coil, equal to it in length, is raised on a stand so as to enclose the bar, and fixed with a binding screw when it does. Then a current is sent through the coil; then the coil is released and moved gradually down, pulling the bar with it, till the latter breaks away, and the deflection of the pointer is noted at which this occurs. This affords an estimate of the hardness of the steel. For example, a bar A, gives a maximum attraction, 9·6; a second bar, B, 15·5; a third, C, 16·6. It is inferred that A is considerably harder than B and C, and of the two latter, C is harder than B. Precautions are taken in the apparatus to prevent injury to the parts from the sudden recoil when the hold of the coil on the bar ceases.

RADIATION FROM INCANDESCENT PLATINUM.—M. J. Violle has made a number of determinations of the intensity of the red light emitted by platinum at temperatures between 900° C., and 1775° C., its fusing point. He gives an empirical formula representing these results, the intensity I of the light at the temperature t being —

$$\log I = -8{\cdot}244929 + 0{\cdot}011475\, t - 0{\cdot}000002969\, t^2.$$

From this formula he deduces that the intensity of the red light would attain a maximum at a temperature of 1933° C.

RESISTANCE OF HEATED CARBON.—M. Borgman finds that heating to redness diminishes the resistance of wood charcoal, anthracite, plumbago, and Carré's coke and carbons. The thermal coefficients for 1° Centigrade are—

Wood Charcoal	0·00370 (between 26° and 260° C.)
Donnez Anthracite	0·00265 (between 20° and 260° C.)
Alibert Plumbago	0·00082 (between 25° and 250° C.)
Coke	0·00026 (between 26° and 275° C.)

Even a feeble radiation notably diminishes the resistance of a plate of wood charcoal and the resistance of pine, elm, and ebony falls markedly between 100° and 125° C.

THE SPHYGMOPHONE.—At the recent inaugural meeting of the Medical Society of London, Dr. Richardson exhibited his latest form of sphygmophone for magnifying the beating of the pulse. It consists of an ingenious combination of the sigmograph, by which the beating of the pulse is graphically delineated on paper, the microphone, which magnifies sound, and the telephone, which so marvellously enhances the power of hearing; and its effect is to render the beating of the pulse distinctly audible. The clock part of the sigmograph is replaced by a microphonic slide, the working power is a small bi-chromate battery, a sigmophone, then a rest for the wrist, and finally a Bell telephone. The principle is that when the pulse is working the needle a series of motions are made along the microphonic slide instead of along paper, and the sounds thus produced are communicated from the microphone to the telephone. By modifying the battery power the intensity of the sounds can be increased, so as to be heard thirty yards from the instrument, or so diminished as to be quite inaudible to a patient, and to require that the physician shall apply the telephone to his ear to be able to distinguish them. In its present stage of development Dr. Richardson said the sphygmophone was not so applicable to the cardiac as to the wrist pulse, but he had almost arrived at an instrument which he anticipated would indicate failure of chest movement in particular parts of the chest. An experiment with the instrument was then made, and the sound of the pulse beating at the wrist of one of the gentlemen present made audible with different degrees of intensity. Dr. Richardson then gave an account of his own experience with the instrument in specially indicating palpitation, aortic deficiency, increased and deficient arterial relaxation, partial intermittence, and anæmia, and his reasons for believing

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that its use would throw increased light on these derangements of the circulation.

ELECTRIC DISCHARGE IN GASES.—Messrs. Warren De la Rue and H. W. Müller, from a number of experiments on the spark given by their chloride of silver battery in rarefied gases under pressure, have arrived at the following conclusions:—

1. For each gas there is a minimum pressure corresponding to a minimum resistance to the passage of the spark. If the pressure be diminished below this minimum the resistance rapidly increases.
2. There does not seem to be any condensation or dilatation of the gaseous medium in the neighbourhood of the electrodes.
3. The discharge is accompanied by a sudden expansion of the gas, which does not appear to be simply due to heating. The expansion ceases instantly with the discharge.
4. The relation which exists between the pressure and the difference of potential necessary to produce the discharge between two plane surfaces, at a constant distance, may be represented by a hyperbolic curve; it is the same for the difference of potential and the explosive distance when the pressure is constant. The resistance to discharge between two plates varies as the number of interposed molecules.
5. The law does not hold for points. We have demonstrated formerly that under a constant pressure equal to an atmosphere the potential varies as the square root of the distances.

   With a constant battery of 11,000 elements the explosive distance has been sensibly in inverse ratio to the pressure from 1·5 mm. to 15 mm.
6. The electric arc and the stratified discharge in vacuo appear to be modifications of the same phenomenon.

Proceedings of Societies.

PHYSICAL SOCIETY.

THE meetings of this Society were resumed for the season, on Saturday, November 8, Professor W. G. ADAMS in the chair. The first paper was: "*On an Analogy between the Conductivity of Heat and the Induction Balance effect of Copper-Tin Alloys*," by W. Chandler Roberts, F.R.S. Mr. Roberts traced a remarkable resemblance between a curve representing the induction balance effect of the copper-tin alloys, published by him in June last, and the curve of Calvert and Johnston for the conductivity of heat, and, on the other hand, he showed that the induction curve does not agree with Mathiessen's curve for the electric conductivity of the same alloys. The author showed that the two alloys, which occupy critical points of the curve (Sn Cu_3 and Sn Cu_4), are of much interest. Possibly both are chemical combinations, and the wide difference in the position they occupy probably marks a difference of allotropic state. For the solution of such question, however, Mr. Roberts considered that we might look with confidence to Professor Hughes' beautiful instrument, which, he hoped, will also enable us to determine whether the relation for conductivity for heat and electricity is really as exact as it has hitherto been supposed to be.

As supplementary to this subject, Dr. O. J. LODGE stated that he had compared the conductivities of six bars of the tin-copper alloys, as measured by the balance and by the Wheatstone-Bridge, and found them to agree very closely on the whole. The Bridge results confirmed the resemblance traced by Mr. Roberts still more than the induction balance results.

Professor HUGHES expressed his opinion that existing tables of metal conductivity were erroneous. They disagreed among themselves, and the induction balance showed that it was impossible to get two pieces of the same metal exactly alike, hence the variation of specific conductivity results.

Professor AYRTON stated that at a former meeting he had suggested that the electric inertia of the different specimens of metals tested might cause the difference between the results obtained by the Wheatstone-Bridge and the induction balance. Mathematical calculation had since led him to the conclusion that the inductive effect is not proportional to the resistance of the metal tested, but to a *power* or exponential of the resistance.

Professor HUGHES replied that as the inductive effect of the metal was destroyed by cutting it so as to interrupt the circuit in it, it was reasonable to suppose that the said effect was due to induced currents circulating in the metal, and therefore was proportionate to the conductivity of the metal.

Captain ARMSTRONG exhibited a standard Daniell cell, formed of a porcelain vessel, with a porous partition, dividing it into two compartments. In one the zinc plate was immersed in a solution of sulphate of zinc, in the other the copper plate in a solution of sulphate of copper. To use the cell as a standard it was only necessary to connect the two liquids by a cotton string, moistened with water. This arrangement prevented mixing of the liquids, as the string could be withdrawn after use. The resistance was high, but it was a constant standard of electro-motive force.

Professor GUTHRIE mentioned that Professor Pirani, of Melbourne, in a letter to him, had signalled the fact that when a dilute acid was being electrolysed the positive electrode, if made of iron, became incandescent below the surface of the liquid. Professor Guthrie had found this to be true, not only for iron, but for other metals, and that it could hardly be due to oxidation, because it took place not only at the cuthode or positive electrode where oxygen was evolved, but also at the anode, where hydrogen was evolved. The incandesence appeared to him to be due to resistance. The author exhibited his experimental results, which, he did not doubt, had already been obtained by Professor Pirani himself. The positive electrode, when immersed in the electrolyte, was seen to get red-hot, and to wobble about. As the liquid heated the red glow became fainter. The negative electrode, on the other hand, emitted a bright light, accompanied by a spluttering noise. The light was tinged with the characteristic colour of the flame of the metal of which it was composed; in the case of a copper electrode, for example, it was greenish. These effects were shown by Professor Guthrie with iron, copper, and platinum electrodes, in dilute sulphuric and dilute nitric acid.

In reply to Professor ADAMS, Professor GUTHRIE said he had not yet examined the flame by the spectroscope; and, in reply to Professor FOSTER, he stated that the battery power used was 50 Groves cells. He asked for suggestions as to the cause of the phenomenon.

SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of the Society of Telegraph Engineers, held Nov. 12th, Major BATEMAN-CHAMPAIN (president) in the chair, the minutes of

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the last meeting having been read and confirmed, the president stated that the reception of the delegates of the International Telegraph Conference held at South Kensington had been spoken of by the foreign delegates in high terms. The reception fund, which had been raised by voluntary subscription, was found to be in excess of the actual expenses by £200, and this sum it had been generally agreed by the subscribers to be devoted to the expenses in connection with the Ronald's Library; it being necessary, under the terms of the will, to have the books bound, the sum would be devoted chiefly to that purpose.

The debt incurred by the Society to meet the general expenses had been paid off by a loan from some members of the Society, the agreement being that the loan was to be paid off in annual instalments in seven years, but judicious management had enabled one-third of this debt to be paid off in the first year.

The president also alluded to the death of Sir W. Fothergill-Cooke, which took place in June of the present year, and stated that a memoir of that gentleman would appear in the proceedings of the Society.

A paper by Mr. J. R. PREECE, on "The Indo-European Telegraph Line between Teheran and Bushire," was then read by the secretary.

This line was incidentally referred to in a previous paper, which had appeared in the proceedings of the Society.

The Indo-European line was not erected without very great difficulty, arising from the obstacles offered by the Persian Government, and the continual interruptions to the line from wild tribes: the wires were continually cut, especially between Shiraz and Bushire. When the line was first opened it was arranged tha Persian and English clerks should work alternately, but this arrangement did not work at all satisfactorily, and a second line was commenced, which was to be under European control entirely. This line was finished in 1867, when Major R. M. Smith, R.E., announced its completion. A line was next commenced by Messrs. Siemens over the Caucasus.

The first of these lines gradually fell into decay, and in 1870 only about 1,000 insulators remained on the poles.

The final convention which was made with reference to an Indo-European line was arranged by Mr. Ronald Thomson and Major Champain, and was most satisfactorily carried out.

As regards the line with which the paper chiefly dealt, its length was about 800 miles, running for the first portion of its distance over a plain, and then over very hilly and broken country, with here and there a flat portion; sometimes spans of 200 to 1,200 yards were required. Bridle paths were carried along the whole distance of the line to enable it to be maintained. No. 5 wire was originally employed, but No. 3 was now adopted; there are three wires on the poles. The poles were partially of wood, partially of iron, the Siemens and the Hamilton pattern being both employed. A larger number of Siemens poles (2,000) were subsequently erected. The poles are 80 yards apart, as a rule, and are called "strainers" and "intermediates," they rise 14 feet above the ground, and the lowest wire is 11 feet off the ground; the wires are fixed at the straining poles by wedges in the insulators. They are not secured at the intermediate poles, but run through hooks. In the latest form of straining insulator a cam is used instead of a wedge, but it is stated not to be successful.

The line is under the management of 1 director, 2 superintendents, 6 inspectors, and 22 clerks. The head-quarters are Bushire, Shiraz, Isfahan, and Teheran. The linemen are natives, as are also the guards, who patrol the line continually.

Daily tests are made from 9 a.m. to 9.30 a.m., insulation and conductivity tests being taken, the latter are made with the lines looped. Tests are made first in one direction and then in the other.

The inspectors who examine the line have a portable sounder and battery, which they take with them. Faults are of frequent occurrence, but occur more seldom than formerly.

In the last year there were 5 faults, lasting 57 hours, which stopped communication entirely; 11 faults, lasting 113 hours, which stopped 2 wires; and 52 faults, lasting 497 hours, which stopped one wire only.

Contacts frequently occur from the wires breaking at the wedge; binding the wire at the intermediate poles did not prevent this.

Pole shooting by the Arabs use to be frequent, and poles were often broken by this. Hamilton poles bear this usage best. It was stated that as many as 60 bullet-holes have been found in a pole. Between 1874 and 1875, 214 poles were destroyed by this means, 88 between 1875 and 1876, 45 between 1876 and 1877, and 21 between 1877 and 1878.

Cairns of stone built around the poles partially stopped the practice.

Cracked sockets were frequently found, the cause of which was doubtful.

The insulation of the line averaged 350 megohms in fine weather, and 1 megohm in wet. During very foggy weather the leakage was sometimes so great that communication was entirely stopped.

It is intended to try Johnson and Phillips' insulators on the worst section.

The instruments first used were sirgle current Morse, with polarised relays; but double current apparatus were afterwards adopted, with great advantage.

The static charge was very evident, and also the induction between wire and wire. To prevent the latter it was found necessary to put the two top insulators, which were formerly bolted together, further apart. The batteries employed were of the Minotto form. For locals, old Morse paper, in the place of sawdust, was found to be very efficient, the resistance of the battery being very low.

In 1872 Fahie's duplex system was tried successfully between Teheran and Shiraz, but was not found necessary.

In the discussion which followed the reading of the paper—

MAJOR CHAMPAIN said that the overland route was selected in consequence of the failure of the first Red Sea cable. He pointed out that the most difficult part of the original route was between Bagdad and Fao, at which point the Indian Government were to have carried on the line: 500 miles passed through desert country peopled by hostile Arabs.

The first line was opened in 1864, but the working was not satisfactory. The line opened by Messrs. Siemens in 1870, passed via Belgium, Berlin, Warsaw, Odessa, Kertch, Tiflis, and Teheran, and was opened simultaneously with the British Indian Cable line. The delays on the Overland line were very slight.

Mr. C. F. VARLEY pointed out that the real cause of the failure of the first Red Sea cable was its being shipped in a dry state. He argued against the use of wedges for the insulators, as the hammers to drive them in must be detrimental to the porcelain cups. Cobwebs, he stated, did not lower the insulation of a line.

Mr. TREUENFELD considered that the wedge insulators answered satisfactorily, and were not liable to breakage.

At the conclusion of the discussion a vote of thanks was proposed by Mr. LATIMER CLARK and seconded by Mr. JOHNSON.

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New Patents—1879.

4346. "Galvanic Batteries." R. C. ANDERSON. Dated Oct. 24.

4354. "Improvements in or applicable to electric lamps." A. S. HICKLEY. Dated Oct. 25.

4400. "Improvements in and relating to the generating, storing, and application or utilisation of electricity, and to apparatus therefore chiefly designated for lighting, telegraphic, and plating purposes." W. R. LAKE (communicated by E. J. Houston and E. Thomson). Dated Oct. 29.

4404. "Electric Batteries." A. V. NEWTON (communicated by F. Tommasi). Dated Oct. 29.

4428. "Electrical apparatus." E. G. BREWER (communicated by E. A. Chambrier). Dated Oct. 30.

4440. "Telephones." J. H. JOHNSON (communicated by C. Ader). Dated Oct. 31.

4456. "Apparatus for containing and protecting surface and underground telegraphic wires." J. T. KING (communicated by C. Linford). Dated Nov. 1.

4534. "Dynamo-electric and electro-dynamic machines." C. W. Siemens. Dated Nov. 6.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

926. "Electro-dynamic and dynamo-electric apparatus." M. P. W. BOULTON. Dated March 8. To avoid the small distance over which any given magnetic poles act in electro-motors, a pair of electro-magnets are connected together by eccentrics, &c., that they both move or rotate in the same direction, while the distance between them changes, now increasing, now diminishing. When this arrangement is used for production of motion from electricity the currents in the electro-magnets are directed by a suitable commutator in such a way that the magnets attract one another while they are approaching, and repel one another when they are separating. Thus the mutual attraction and repulsion of the magnets are exerted through a stroke of as great length as may be desired, while the magnet poles are kept close together through the whole of it.

935. "Galvanic batteries." L. A. BRASSEUR, O. A. E. DEJAER, Brussels. Dated March 10. 8d. Preventing polarisation of battery plates by rotating them so as to expose fresh surface to the solution. The battery is to be used for lighting a buoy by means of a luminous Geissler tube, and the motor is an Archimedean screw put in motion by the tide.

947. "Apparatus for electric lighting." H. J. HADDAN (communicated by C. F. Brush, Cleveland, Ohio, U. S.). Dated March 11. 8d. This consists in an electric lamp in which the upper carbon is provided with a mechanism which alternately keeps it stationary and allows it to advance by gravity, while the lower carbon is fed by the result and force of magnetism caused by the passage of the current through a coil in the main circuit and a coil in a shunt circuit. The lower carbon-holder is attached to a core, movable under the magnetic attraction of the main current, and sometimes of both it and the shunt current.

960. "Dynamo-electric machines." LOUIS SIMON. Dated March 11. 6d. To reduce the warming of the armature it is made flat, and composed of several sheet discs magnetically insulated from each other; both side faces as well as outside being brought under the influence of the magnet poles. These poles are arranged with their highest intensity of magnetism directly opposite the side faces of the ring to act on it. The electro-magnets cover over two-thirds of the whole surface of the armature, making opposite polarity at opposite points of the ring.

1015. "Galvanic batteries." T. J. HOWELL. Dated March 14. 6d. This cell consists of an outer glazed vessel and an inner porous pot. The latter contains zinc, mercury, ammonia, and water; the former, sulphuric or nitric acid; while between the two cells is placed broken carbon and peroxide of manganese and white manganese. This cell, it is claimed, may be easily cleaned without disturbing the manganese.

1122. "Electric light." G. L. FOX. Dated March 20. 2d. This consists in making a continuous electrode of plumbago mixed with a bad conductor like magnesia, zirconia, lime, steatite, &c., in a proportion giving a resistance suitable to the electromotive force of the current. With a current of 140 volts. E.M.F., the incandescent electrode should have a resistance of 300 B.A. units. (*Not proceeded with.*)

1175 "Electric candles." JOHN IMRAY (communicated by the Société Générale, Paris). Dated March 24. 6d. Instead of the parallel candles of the Jablochkoff candle two metallic wires are, according to this invention, placed parallel to one another, or slightly inclined, each being entirely enclosed in an insulating material consisting chiefly of mineral carbonaceous matter such as anthracite, which is moulded so as to surround the two wires in cylindrical form, with a thin middle rib uniting the two cylindrical coatings. Thus is formed a cylindrical candle with two metallic wicks which, throughout the body of the candle, are insulated from each other, but which at the summit are electrically connected by the fused matter. The wire wicks and their composition are consumed in the arc. Magnesia, agglomerated with chloride of magnesium round the wires, gives a brilliant lustre owing to separation of the magnesium. The tip of the candle is furnished with a kindler, or match of carbon paste; and zinc is blended with the composition to facilitate rekindling if the candle goes out. Instead of zinc or metallic powder, metallic oxides may be used for this purpose.

1181. "Iron telegraph posts." F. C. GLASER. Dated March 25. 4d. This consists in making the posts of a trough-shaped cross-section, giving less weight, greater strength, and more surface for fitting cross-arms. (*Not proceeded with.*)

1203. "Coating the surface of moulds with black lead for electrotyping." E. A. CLOWES and J. BATEY. Dated March 26. 2d. A flat-faced brush is caused to vibrate rapidly by mechanism, and the moulds are placed on a table which is moved by a screw so as to bring them slowly under the brush, which is fed with black lead from a hopper. (*Not proceeded with.*)

1207. "Producing electric lights." T. A. DILLON. Dated March 26. 4d. To a central steam or gas meter the author attaches a strong air-reservoir, with air-compressing pump driven by it, and from this reservoir the air is led by a branching system of pipes to streets, factories, &c., where it actuates small air-engines and dynamo-machines, which feed electric lamps. Waste power, such as waste steam, tidal or river power, wind, can be used to store the compressed air-reservoir.

1229. "Apparatus for raising submerged r operty." H. W. HEMSWORTH. Dated March 28. 2d. Pontoon fitted with grappling arms is lowered, and after these have taken hold of the object to be raised, cable, anchor, or ship, air is pumped into the pontoon by

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means of pipes, and the buoyancy of the latter raises the cable, &c., to the surface. (*Not proceeded with.*)

1242. "Electric telegraphs." E. A. COWPER. Dated March 28. 6d. This relates to improvements in Cowper's writing telegraph (patent 2385, 1878), by which, instead of making the movements of the style introduce a varying resistance into the circuit, it is made to vary the strength of the current by bringing into the same a varying number of battery cells, or parts of cells. Also, instead of employing battery currents, it proposes to use induced currents generated by magnetic cores movable in solenoids.

General Science.

A NEW THEORY OF SEA-SICKNESS.—Nitrite of amyl has proved itself an alleviator of sea-sickness, and this circumstance has led Dr. Henry Naylor, of Edinburgh, to conclude that the organic cause of this distressing malady is cerebral anæmia, or insufficiency of blood in the head. According to this view, the rapid swinging of the vessel and the body with it irritates the eyes and vision, and this by reflex action produces a spasm of the cerebral capillaries, which explains the feeling of faintness and giddiness that suddenly comes on as the vessel gives a big swing. The sudden emptying of the cerebral vessels causes the stomach to sympathise, and efforts to vomit are the result. These symptoms are most violent when the subject sits or stands *with his eyes open*. If he lies down the change of position relieves the anæmia, the faintness and giddiness pass away, and the sickness ceases. Occasionally even the recumbent attitude does not give relief if the eyes are kept open, but when these are shut the symptoms are not at all felt. Dr. Naylor has known ladies who were never comfortable at sea until they lay down with their eyes shut, and then they could even take their meals. The anæmic theory is supported by the fact that brandy and other stimulants give considerable relief for a time, which would not be the case did cerebral congestion have to do with sea-sickness. Prolonged sea-sickness is explicable under this theory by a weakening of the action of the heart, which keeps up the cerebral anæmia and as a consequence the sickness. Dr. Naylor states that nitrite of amyl usually does good as a remedy for sea-sickness if resorted to at once, for being an anti-spasmodic, it relieves the spasm of the cerebral vessels, and enables the brain to fill itself with blood. But if it fails the persistent sickness sets in owing to the weakening of the power of the heart, and for this alcoholic stimulants in small doses, frequently repeated, give great relief.

REFRIGERATED STORE-HOUSES.—A large artificially cooled store-house has been erected at Boston by the Massachusetts Chemical Refrigerating Company, for the storage of all kinds of provisions perishable in warm air. The store-house is built so as to be as nearly as possible insensible to outside atmospheric changes, then the heated gases inside are drawn off by a powerful exhaust fan, while cold, pure, and dry air is supplied in its place. The process is a continuous one, so that a constant circulation of the refrigerated air is kept up throughout the various compartments of the store. Evaporation of ammonia is the means employed to produce the artificial cold.

The building referred to contains 94,000 cubic feet of space, some 80,000 of which are now occupied by no less than 10,000 packages of butter, 300 barrels of beef, 550 cases of pork, 3,500 dozen eggs, 7,800 lbs. dried apples, and about two tons of cheese, the property of different produce and commission merchants. It is expected that similar stores will soon be put up in various American mercantile centres, and that refrigerated steamers and railway cars will be employed for the traffic between them. The Swedish Government also introduced ice-refrigerated waggons on the State railways last summer for the transport of provisions.

GAUMET'S TELEMETER.—A neat little pocket telemeter invented by M. Gaumet, a French lieutenant, was illustrated in *La Nature* for Oct. 1. It is provided with two mirrors like a pocket sextant for surveying, and in order to determine the distance of an inaccessible point it is only necessary to measure a short base line of twenty metres and take two sights at the end of it, then refer to a table provided with the instrument for the distance in question.

THE WRITING BALL, or Danish Type-writer, of Sofus E. Holten, which was awarded a gold medal at the recent Paris Exhibition, is now manufactured by the India Rubber, Gutta Percha, and Telegraph Works Company, Silvertown. It is worked by finger keys arranged round the top of a ball or spherical surface, and produces Roman characters. By using carbonic paper a number of copies may be made at one operation; and the writing may also be transferred to a lithographic stone and printed in the ordinary manner. Compared with other type-writers it has a more direct action, and carries more type.

LEWIS' PATENT CHEQUES FOR PREVENTING FRAUD.—We would draw the attention of our readers to these useful cheque-books, whereby a forgery if not rendered impossible is at least limited to a certain amount which is not deadly. Thus if a forger obtains a cheque for £9, he cannot possibly palm it off for £900 by the mere addition of cyphers, because it will express on its own face by a simple device that it is not current for any sum over £20.

EXPERIMENTS ON IRON WIRE.—From the experiments by Mr. J. T. Bottomley, a report on which was read before the British Association at Sheffield, it seems that the prolonged application of stress has a very remarkable effect in increasing the strength of soft iron wire. Comparing the breaking weights for a wire quickly broken with those for the same wire slowly broken, it is found that in the latter case the strength of the wire is from 2 to 10 per cent. higher than in the former, and is on the average about 5 or 6 per cent. higher. The result as to elongation is even more remarkable, and was certainly more unexpected. In the case of the wire quickly drawn out, the elongation is, on the average, more than three times as great as in the case of the wire drawn out slowly. There are two wires for which the breaking weights and elongations are given in the tables accompanying the report, both of them "bright" wires, which showed this difference very remarkably. They broke without showing any special peculiarity as to breaking weight, and without known difference as to treatment, except in the time during which the application of the breaking weight was made. One of them broke with 44 lbs., the experiment lasting one hour and a half; the other with 47 lbs., the time occupied in applying the weight being thirty-nine days. The former were drawn out by 28·5 per cent. on its original length, the latter by only 4·79 per cent. It was found during the breaking of the wires slowly—several months—that the wire becomes alternately more yielding and less yielding to stress applied. Thus, from weights applied gradually between 28 lbs. and 31 lbs. or 32 lbs., there is

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very little yielding and very little elongation of the wire. For equal additions of weight between 33 lbs. and about 37 lbs. the elongation is very great. After 37 lbs. have been put on, the wire seems to get stiff again, till a weight of about 40 lbs. has been applied. Then there is rapid running down till 45 lbs. has been reached. The wire then becomes stiff again, and often remains so till it breaks.

PIKE'S PEAK.—The United States Signal Service Station at Pike's Peak is the highest signal station in the world. It was opened in the month of September, 1873. The point is wonderfully favoured by nature for the study of astronomy and meteorology. The rarity of the atmosphere brings out a remarkable brilliancy and clearness to the stars and all the heavenly bodies. The nights are almost always cloudless, and cloudy days are the exception. Nine-tenths of the storms are below the Peak. The best and most complete report of the last total eclipse of the sun received at Washington was the report of Professor Loud, of Colorado College, from observations taken at Pike's Peak.

The signal station is under the charge of three sergeants. These officers are detailed from the United States army because of their special qualifications.

The summit of Pike's Peak contains 60 acres. It is 14,336 feet above the level of the sea. On the highest point of the summit stands the signal station, a rough stone building, 24 by 30, one storey in height. It is divided into four rooms—officers' room, kitchen, store-room, and wood-room. And here in this bleak spot, nearly 20 miles from the habitations of man, though three miles nearer the heavenly regions than most parts of New England, these men live the larger part of the year. The station is three miles from the timber line, where the greater part of vegetation ceases. Short grass, tufted with delicate Alpine flowers, struggles for an existence against the frigidity of the atmosphere, and creeps towards the mountain top; but there are hundreds of acres of cold grey and reddish rocks where not a vestige of verdure exists.

Like the dwellers of the Arctic regions, the inhabitants of Pike's Peak have but two seasons—summer and winter. Two months of summer—August and September—and 10 long, cold months of winter. During the summer of 1878 upwards of 900 people, in parties of from five to thirty, visited the Peak, among them many ladies. To behold a sunrise from the Peak visitors often remain overnight at the station.

The duties of the officers are various. Seven observations are taken daily; all storms are closely watched and each special and distinctive characteristic duly recorded. Monthly reports of these records are sent to headquarters at Washington. A Government office at Pike's Peak is no sinecure, for the officer must buffet all storms and brave all weathers. Occasionally an electric storm visits the Peak. There is but little thunder accompanying these storms, but the mountain seems all on fire.

The summer months are occupied in preparing for the long siege of winter. During the months of August and September upwards of 3,000 pounds of the usual variety of family stores, and about 25 cords of firewood, are snugly stowed away. These are all carried to the Peak in small quantities on the backs of donkeys.

THE COMPOUND NATURE OF THE ELEMENTS.—Continuing my researches into the nature of the so-called elements, I have found that when carefully distilled metallic sodium was condensed in a capillary tube, placed in a retort, and heated in a Sprengel vacuum, it gave off 20 times its volume of hydrogen. Phosphorus, carefully dried and submitted to the same treatment, gave off 70 volumes of a gas which appeared to consist chiefly of hydrogen. Although it gave some of the lines of phosporus, it was not PH_3, as it had no action on solution of cupric sulphate. A specimen of magnesium, carefully purified by Messrs. Johnson and Matthey, gave me a magnificent series of coloured phenomena. The hydrogen lines first appeared, then the D line—not the sodium line, be it understood, for the green line was absent—and, lastly, the green line of magnesium (*b*), and then, as the temperature was increased, mixtures of all these lines, with the blue line, the D line being always the most brilliant. In this experiment only two volumes of hydrogen were collected. From gallium and arsenic no gas of any kind was obtained. From sulphur and some of its compounds sulphurous anhydride was always obtained. From indium hydrogen was given off in vacuo before heating, while from lithium no less than 100 volumes of hydrogen were given off. The conditions of the experiments were always the same, the only variable being the substance itself.—*Norman Lockyer.*

The Telegraph Construction and Maintenance Company's ship *Kangaroo* will shortly sail with 120 miles of cable for the New Zealand Government. The s.s. *Scotia*, belonging to the same company, has taken on board the remaining portion of the Cape cable, and has left the Thames for Aden. The laying of this cable will be completed next month. To obtain the best course for the bed of the cable no less than 118 soundings have been taken between Zanzibar and Aden.

We are informed that the Direct Spanish Cable *via* Bilbao has been repaired, and is now open for traffic.

The Western Union Telegraph Company's report for the year ending June 30th, 1879, shows a nett profit of 4,830,440 dollars.

The following are the final quotations of telegraphs for 12th Nov.:—Anglo-American, Limited, 55½-56½; Ditto, Preferred, 81½-82½; Ditto, Deferred, 31½-32½; Brazilian Submarine, Limited, 7⅛-7⅜; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 1⅜-2¼; Direct Spanish, 10 per cent. Preference, 11¼-11⅝; Direct United States Cable, Limited, 1877, 10⅜--10⅝; Eastern, Limited, 8⅛-8⅜; Eastern, 6 per cent. Debentures repayable Oct., 1883, 102-105; Eastern 5 per cent. Debentures repayable Aug., 1878, 103-105; Eastern, 6 per cent. Preference, 12-12½; Eastern Extension, Australasian and China, Limited, 8⅛-8⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 1-2 pm; Ditto, registered, repayable 1900, 1-2 pm; German Union Telegraph and Trust, 7¼-7½; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 11-11½; Great Northern, 8½-8¾; Indo-European, Limited, 22½-23½; Mediterranean Extension, Limited, 2⅝-3¼; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Reuter's Limited, 9-10; Submarine, 227-232; Submarine Scrip, 2-2½; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference 7¼-7¾; Ditto, ditto, Second Preference, 6⅜-7¼; Western and Brazilian, Limited, 4⅛-4⅜; Ditto, 6 per cent. Debentures "A," 98-102, Ditto, ditto, ditto, "B," 96-100; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 35-36; Ditto, 6 per cent. Bonds, 106-108 Ditto, Second Bonus Trust Certificates, 2⅝-3; India Rubber Co., 12¾-13½; Ditto, 6 per cent. Debenture, 104-108.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 164.

TECHNICAL EDUCATION.

THE recent lecture delivered by Professor Ayrton at the City and Guilds of London Institute on "The Improvements Science can Effect in our Trades and in the Condition of our Workmen," has called attention to the want of technical education which exists in England. In this particular branch of education the other European countries are no doubt ahead of us, but the beneficial results of this training, we think, are, at present at least, by no means so apparent as enthusiastic professors would have us suppose. Technical education in England, it is true, is, at present, not carried on to the extent that it is in the European States; and in America, we believe, it is equally behind-hand; yet we must confess we fail to see that either the English or American scientists and engineers are being ousted by the foreigner. Why is this the case? Compare any of the laboratories or workshops attached to the English schools or colleges with the large and well-fitted establishments we find in France, Germany, Russia, and Switzerland, and the result will be decidedly unfavourable to our own country, both as regards the numbers and completeness of the same. With such advantages, which, we believe, are fully appreciated and made use of, how is it that we are not beaten quite out of the field? It cannot be that English or Americans are superior in intellect to the rest of the world. Is the answer to be found in the fact that the technical education in the foreign schools and colleges is not such as to train the mind so as to enable it to apply the knowledge with which it is stored? It is not sufficient that the theory of a subject be thoroughly understood unless the proper way to apply it in practice be also thoroughly explained. It is the constant expression of practical men that "it is all very well in theory, but practically it does not answer," the fact being that those who advanced the theory, or who have had it instilled into them, not only lack the practical knowledge, but the way to apply the theory to the practical knowledge. This may partly arise from the appliances for studying the theory being of a too perfect nature, that is to say, from their not leaving sufficient difficulties to be overcome, the laborious overcoming of which often teaches a vast deal more than the easy following out of a theory by complete appliances. Perhaps the majority of the most wonderful discoveries in scientific research have been made with the simplest apparatus. The well-known story of Sir Humphry Davey, who, when asked to show the laboratory in which he made his renowned researches, produced a small tray with a few articles of everyday life on it, together with a few bottles of common chemicals, is an instance of the kind.

Let it not be thought, however, that we would discourage the extension of technical education. The question we would ask is this—Is technical education, as it at present exists, the means of advancing scientific knowledge to the advantage of the nation at large? Does it not require to be supplemented in some way, and is it conducted on a correct basis? Professor Ayrton states that the reason why our engineers have hitherto been considered the first in the world is because they started earliest in the race; but even if we may be considered to have fallen behindhand, the case is not so with America, and we are not aware that technical education is very advanced in that country.

BROOKS' SYSTEM OF UNDERGROUND TELEGRAPH WIRES.

A SYSTEM of underground telegraph wires has been recently invented by Mr. David Brooks, of the United States (a gentleman well known in the telegraphic world as the inventor of the "Brooks' Paraffin Insulator"), which bids fair to be of very great value to telegraph companies and administrations.

The peculiarity of this system lies in the insulating material, which, instead of being a solid, is a liquid. In carrying out the system, the conducting wire or wires are first covered with hemp, cotton, jute, or other cheap absorbent material, which latter is then saturated with melted paraffin wax. The wires thus insulated are then drawn into a tube, which is kept filled with paraffin oil.

The preliminary insulation of the clothed wires with paraffin is not essential to their complete insulation, and if the fibrous material with which the wires are clothed be entirely deprived of moisture and gases in the first instance, ordinary petroleum and other liquids, after they are rendered anhydrous, may be used as insulating media, providing they are maintained in constant and intimate contact with the clothed wires.

The preliminary heating of the clothed wires or cable of wires may be effected in different ways. They may, for instance, be subjected in an oven to a temperature of 300° to 320° Fahrenheit for a sufficient length of time to ensure the evaporation of all the moisture contained in the fibrous wrapping and the evolving of all the gases generated by subjecting the fibres to heat, and then (preferably while it is hot) steeping the cable in heated petroleum or other insulating liquid.

Another plan is to first steep the clothed wires or cable of wires in oil—petroleum or linseed oil, for instance—or other liquid which will not evaporate at a temperature of 350°, for the bath should be

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maintained at about that temperature. After this has been done, the cable may be boiled in water in which chlorine or bleaching powder has been dissolved, so that all traces of acids or gases may be removed. As the clothing of the wires is made somewhat tender by the above treatment, the cable may be wrapped with hemp, jute, or other cheap fibrous strands. The cable is then placed in a bath of any liquid insulating medium—common petroleum, for instance—the said bath being maintained at a temperature of about 230° Fahrenheit, and this steeping is continued until the insulation resistance ceases to increase. The cable being now deprived of all moisture and gases, and thoroughly insulated, is pulled through a pipe—an ordinary lap or butt welded iron tube, for instance—in doing which the fibrous clothing of the wires is protected by the above-mentioned wrapping.

Before the cable is pulled into the pipe, the interior of the latter is deprived of all moisture. This may be done by heating the pipe or by introducing into it pulverised quicklime, which absorbs the moisture.

The manner of connecting together the pipes containing the cables and maintaining the wrappings in a proper insulated condition after the pipes are laid, will be best explained by reference to the accompanying figures.

In Fig. 1, A is the iron pipe through which the wires run, and which is kept filled with the insulating oil. As it is necessary to have joint-boxes at certain distances along the line, these boxes are constructed in a chamber form, as shown by C. This chamber is made in two pieces, the lower of which has sockets into which the pipes are screwed. The upper part of the chamber is screwed into the lower, so that it can be removed if necessary, and the joints of the wire got at. P is a small plug screwed into the top of the chamber, which can be removed when the pipes are being filled with oil, so that the contained air can escape and the oil rise in the chamber and cover the joints *i*. The joints in the wire are made in the ordinary manner by twisting the ends together, soldering them, and then wrapping them over well with the cotton covering. In order to expel any moisture in the chamber, the latter is heated when the oil is poured in.

The oil which is placed in the pipes is by preference refined petroleum, which Mr. Brooks finds, as the result of numerous experiments, to be better than any other kind of liquid.

A supply of this oil is contained in a reservoir T, as shown by Fig. 2. The supply pipe is connected to the main pipe A containing the wires, by a T piece C, as shown. The height of the reservoir or reservoirs—for a long length of line several may be employed—is such that the insulating liquid in the pipes at all points on the route will be under constant pressure, to secure the best insulation and to effectually seal the interior of the pipes and protect the cable from moisture.

The pipes employed are of iron, ⅜-inch thick, and are in 5-feet lengths. They are made of "Juniata" iron, which is of a peculiarly tough and flexible nature. If necessary, the pipes can be joined up in

FIG. 1.

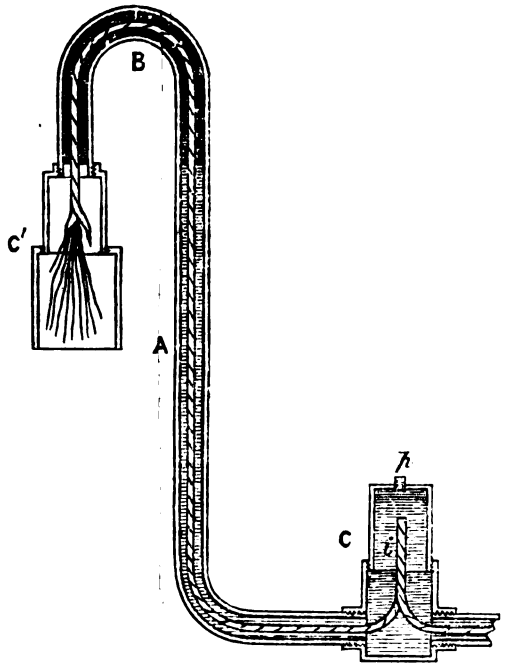
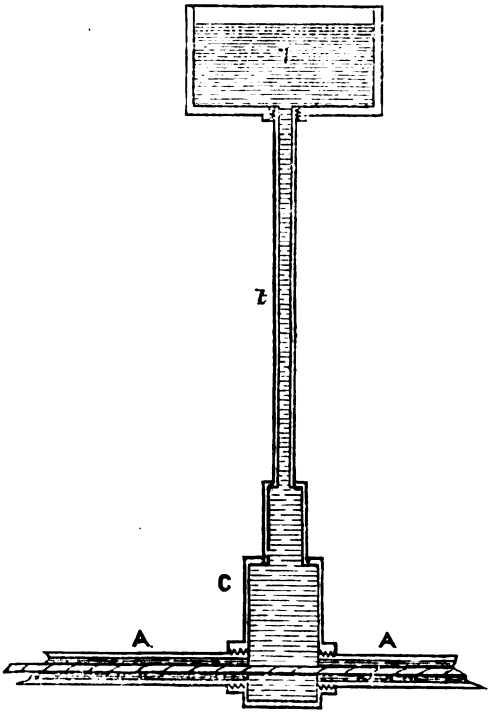


FIG. 2.



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half-mile lengths. The joints of the pipes with one another and with the joint boxes are rendered tight by means of silicate of soda, as it is found that the white or red lead packing usually employed for similar purposes will not resist the action of the oil.

The way in which the wires are led into the test-boxes at the offices is shown in Fig. 1. The pipe is brought in by a bend B, which is filled with a solid material called "Tunyoap," a product of petroleum, shown by the shaded portion.

Two sockets, one larger than the other, are screwed one into the other and on to the end of the pipe, as shown. The wire cable, being brought out at this mouthpiece, is untwisted, and each wire led away to the test-box terminals in the office.

The Brooks' system of underground wires has, among others, the following advantages :—

1st. Its cost, where as many as twenty conductors are upon one route, is only about half that of the same number of conductors when strung upon poles. As the number of conductors increase, or the greater the number of wires in one tube, the less the expense per wire. Double wires for telephone circuits cost only about four dollars per mile; they are made of No. 24 Birmingham gauge. 150 of these coated wires can easily be drawn into 1-inch pipes.

2nd. Durability. There is nothing in the system perishable except the outside of the iron pipe. The pipe will last more than twice as long as when used to distribute gas or water, for then oxydation is most rapid on the inner surface of the pipe. No chemical changes take place with the copper conductors, the inner surface of the pipe, the cotton covering, or with the oil itself, which is the most stable of known substances. It is neither affected by acids, alkalies, or re-agents of any kind, but remains in the same condition in the pipe as it has for ages in the earth.

3rd. The insulation is equal to that of gutta-percha-covered underground conductors.

The electro static capacity is not over one-tenth of that of conductors insulated with gutta-percha; but as the covering is much thinner where cotton and oil are used, the specific inductive capacity is less than the one-hundredth that of gutta-percha.

4th. The conductors, being sealed in a pipe, are not interrupted by breaks, contacts, and other causes which affect overhead wires, and the electrical condition of the conductors being constant and unchangeable by atmospheric conditions, are capable of being worked to much greater capacity, especially so when the duplex, quadruplex, or automatic systems are employed.

5th. Telephone circuits are worked by this system without perceptible inductive disturbance from currents upon the other wires, in the same pipe, or any cause whatever.

The system has been laid across the Dalaware river, which is 3,700 feet across at its surface. 4,000 feet of cable, containing forty-four conductors, has been used for the purpose. The Irrawaddy and the Christiana rivers, and many others, have also been crossed by means of Mr. Brooks' system, and with perfect success.

A trial of Mr. Brooks' system has been made in Belgium, and the results of tests made there by Messrs. Dumont and Girard, of the Belgian Government telegraphs, are as follows :—

A test of a length of 7,883 metres, when fresh laid, showed an insulation resistance of 1787·9 megohms per kilometre. A test of the same wire made later on in the day, gave 1656·9 megohms. A test made nine days later showed that the insulation had fallen to 451·3 megohms; tests on intermediate days showed that this fall had been gradual. These tests were made after one minuts'e electrification. A subsequent test after ten minute's electrification, made about five weeks later, showed a result of 439·5 megohms. Three weeks later the oil was renewed, and the insulation ran up to 2,000 megohms per kilometre.

Mr. Brooks states that the fall of insulation in the first instance is due to the oil absorbing moisture from the cable and pipes, and that after the oil is renewed the insulation remains permanent.

Inductive capacity tests gave an average result of ·013 microfarad per kilometre.

We understand that the Western Union Telegraph Company have purchased the United States patents of Mr. Brooks for this system for 331,500 dollars.

MR. W. L. CARPENTER ON DAILY PRACTICAL APPLICATIONS OF ELECTRICITY IN AMERICA.

A MOST interesting lecture was delivered by Mr. W. Lant Carpenter, B.A., B.Sc, on Monday, Nov. 10th, at the British Museum and Library, Bristol, the subject being: "Daily Practical Applications of Electricity in America."

Mr. Carpenter, at the commencement of his discourse, remarked that amongst the various improvements and things which were being tried in the United States, America, one that struck him as much as anything was the extraordinary development, within the last two or three years, of the application of electricity to the purposes of practical life. He then explained, for the benefit of the unscientific, the action of a battery in producing magnetism, heating platinum wire, &c. Passing on to the construction and working of electric bells, the lecturer explained their action. Examples were given of the ringing of bells in this way—house bells, mining bells, &c. The practical application of the system to use in dwelling-houses, for the purpose of burglar alarms, &c., was also fully explained, the lecturer pointing out that matters were, of course, so arranged that the circuit of electricity was only kept up by night, and allowed to be broken by day. He gave several remarkable examples of the way in which the system is applied in the United States for the protection of safes, vaults, and other valuable property, alarms being rung in a central office whenever a forcible entrance was attempted in any one of, say, 500 vaults, the alarm indicating which one. The principle of the system was as follows :—The safes are covered externally, and the vaults lined internally, with a continuous casing of two *thin* sheets of metal, separated by an insulating material. The two sheets are connected in the circuit of an ordinary electric bell, placed in the watchman's room, or in any other place where it is advisable, to sound an alarm. If any attempt is made to break into the safe or vault, it must be done through the two

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metallic sheets and insulating material; the result of this is to bring the two metals together, and complete the circuit, and this is *sure* to take place, however great care be taken in making the breach of the burglar, even supposing he knew what he was about, and used a non-metallic tool, which, of course, would not be the case.

Most safes are protected with both closed and open circuits; the former rings a bell when a "scientific" burglar cuts the connecting wire.

Mr. Carpenter also explained another mode of protecting safes and strong-rooms by means of "time," or clock locks, which only permit of their being opened at a given hour. The obvious difficulty which would arise from the stoppage of such clocks before the hour at which their action released the bolts of the safe door, was got over by means of an electro-magnetic arrangement, which could be caused to actuate the clock by a step-by-step motion, and could thus bring it round to the required hour. These clock locks, it was stated, are largely used.

An electric watchman's "tell-tale," the invention of Mr. Batchelor, is employed in some factories. Keys are placed all over the building, to be depressed by the watchman when he goes his rounds; this operates a registering pencil in a clock. The register-sheet, which is changed daily, and which is placed in the manager's office, cannot be got at by the watchman. The man's whereabouts at any hour or minute is thus permanently registered, and can be checked in the morning.

Mr. Carpenter next described the well-known system of call-signals, so extensively used in America.

In speaking of the practical application of electricity to a system of fire-alarms, Mr. Carpenter explained the general system pursued in all large towns in the United States, and spoke of the extraordinary rapidity with which fire-engines are turned out ready for use on receipt of the electric signal. Six or eight seconds was the usual time. Electric signal boxes were fixed in the streets, and any person, on becoming aware of a fire, could turn a handle and communicate at once with the central stations, where the officials would know from which box the signal came. An automatic system was at work in New York, where 500 shops, stores, and warehouses were protected by an apparatus which sounded an alarm in a central office whenever the temperature of any place rose above a given point. Insurance companies charged less premium on places so protected. The statistics of the former are simply startling as regards the efficiency of the apparatus. It has been in successful operation for three years now, and over 100,000,000 dollars' worth of property are now thus protected in New York alone.

The lecturer next alluded cursorily to the electric telegraph, including multiplex telegraphy. In speaking of the electric light, Mr. Carpenter remarked that Mr. Edison claimed to have sub-divided it in such a way that instead of its being necessary to have one very intense light, there might be arranged a great number of less intense lights produced out of the same current. But, as a matter of fact, such had not been done yet for practical daily use. He (the lecturer) was in Mr. Edison's laboratory some few months since, and, as far as he could see, he was no nearer to that than he was two years ago. He did not believe very much in its practical utility for the purposes of street-lighting, and for domestic purposes he was not in the least afraid that it would supersede gas; it was, however, very well suited for the illumination of large halls or spaces.

The next subject was "Telephones," in considering which the lecturer discoursed on their first practical discovery by Dr. Alexander Graham Bell; he then explained how, in Bell's and other Magneto Telephones, electric currents are excited by vibration of an iron disc or diaphragm, set in motion in front of a magnet by the voice; the Microphone of Professor Hughes and Edison's Loud-speaking or Electro-chemical Telephone were also explained.

In speaking of Telephone Exchanges, their recent extraordinary and rapid development in every large town in the United States, and their uses and advantages, were alluded to, and a hope expressed that the subscription for those to be set up in England would be as low as possible, in order that a considerable number of Bristolians might join such an exchange, which Captain Cox and other representatives of the company present were promoting.

In conclusion, Mr. Carpenter urged that if science, practically applied, was to form so large a portion of our daily life, was not that a very strong argument for so arranging our educational work that every child should be instructed in the rudiments of science?

The lecture, which was attended by a crowded audience, was excellently illustrated by views* for the oxy-hydrogen lantern, and by apparatus, a large portion of which was now shown for the first time in England.

GLASS PIERCING BY THE ELECTRIC SPARK.

By M. FAGES.

WHEN the glass, which it is proposed to pierce, is thick, one of the wires from the induction coil should be bedded in a casing of resin sufficiently thick and solid, on one of the faces of the plate of glass. This operation, necessitating the employment of heat, is tedious, irrespective of the fact of the difficulty of removing the resin from the glass when the operation is completed.

The following method is very easy of application, and all the necessary preparations can be made in a very short time.

It is first of all necessary to have a small apparatus which lasts indefinitely, and the simplicity of which is such that any one can construct it for themselves. This apparatus is shown in vertical section by the fig.; it is composed, 1st, of a rectangular plate A of ebonite; 2nd, of a brass wire B, the curved point C of which is fixed or screwed tightly in the plate of ebonite, and is flush with the surface of the same, as shown. This is the whole apparatus.

When it is required for use, it is placed horizontally on the experiment table, or on any other support, and the brass wire B is put in connection with one of the terminals of the induction coil. This done, a few drops of olive oil are dropped on the ebonite

* Copies of these views may be obtained from Mr. Edwar Paterson, of Bedford Street, Covent Garden.

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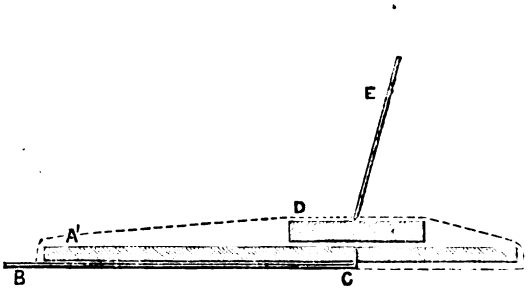
plate around the point C, and the glass plate D, which is to be pierced, is placed over it, care being taken that no bubbles of air are enclosed between the glass and the oil. The olive oil answers perfectly its purpose of insulating the point C. It is probable that any other oil would do equally well.

The things being thus arranged in position, it only remains to place the wire E which is connected to the other terminal of the induction coil, and to make the spark pass.



By displacing the glass laterally, it is very easy to pierce it in a few moments with several holes close to one another.

The single essential condition to be observed in order to make the experiment satisfactorily, is to have the plate of ebonite sufficiently large. It is necessary, in fact, that the spark may be unable to burst out between the wires by following the route indicated by the dotted lines.

BLOWING-UP OF THE S.S. "ADEN."

A very difficult piece of engineering work has been most efficiently carried out by the students of the Imperial Torpedo College, at Taku, China.

An old Peninsular and Oriental steamer, the *Aden*, was moored outside the Taku Bar, some seven miles off the land, where she was used as a receiving hulk and light-ship by the China merchants' Steam Navigation Company. On a fine calm morning, while unloading cargo, with a steam lighter lying alongside her, she suddenly capsized, sinking immediately, and drowning fifty of the coolies employed upon her. At first some hopes were entertained of raising her, as she was only just covered at low tide; but, being an old iron vessel and lying in a heavy sea-way, she began to break up so quickly that all thoughts of getting her up were abandoned, and as she was a source of great danger to other vessels arriving at the bar, it was determined to blow her up. Mr. Betts was requested to undertake the work, with the assistance of some of his students; divers were sent down and the position of the vessel carefully marked out. It was found that the stern of the ship was washed away, and the whole of the after-part sunk in the mud out of sight, leaving the bows sticking up. From the position of the wreck, it was determined to place three heavy torpedoes in her and fire them simultaneously. One 700 lbs. charge was placed well forward in her bows, and a 500 lbs. charge in the waist of the ship on each side. The charges were submerged at low tide, joined up in divided circuit, and the main cable carried to the steam-tug in attendance. At high tide, when covered by about twenty feet of water, they were fired, causing a grand effect. An immense amount of wood and several dead bodies came to the surface, while hundreds of fish of all sorts and sizes went floating by. On an examination being made by the divers, it was found that the bow of the wreck had been blown off in one mass, while the remainder of the vessel had been entirely broken up and sunk into a deep crater which the explosion had formed in the mud.

As Mr. Betts was compelled to return to Tientsin, the work of breaking up the bow was entrusted to the chief student Chan Yu Chun, who decided that it would be best to attack it in detail, using 120 lbs. charges to destroy each rib or beam. Seventeen of these charges were used, when it was found that every portion of the wreck was entirely submerged in the mud, the divers sweeping over it for several days without finding the slightest evidence of the vessel.

Gunpowder was the explosive employed, as no other material was at hand. Platinum wire fuses and the Silvertown firing battery were used to ignite the charges.

The work was one of considerable difficulty, as it was carried out at a season of the year when heavy squalls are of almost daily occurrence, and at a spot where hundreds of junks and fishing-boats, in addition to the steamers, are always about.

NORTH METROPOLITAN TELEGRAPH MESSENGERS' INSTITUTE.

WHO is there, residing in London, or indeed in any large town in Britain, who does not know that merry, agile, and useful member of society, the telegraph messenger-boy? Sometimes the medium of most extensive business operations, and sometimes the bearer of relief-giving messages, or words fraught with acutest pain. For such, the above institute, which is now domiciled at St. Stephen's Hall, Providence Place, Upper Street, Islington, is intended. By paying a small subscription, youths in the Postal Telegraph Service between the ages of 14 and 21 are entitled to use the rooms of the Institute, where educational classes, reading-room, and reference library are provided, and to which it is hoped will soon be added a lending library.

An additional building has been taken for the convenience of orphan members, or for those who are living far from their parents, so that they may have a comfortable home adjoining the Institute.

A debt of £50 having been incurred upon removing from Canonbury Tower to the above premises, for repairs, furniture, and needful appliances, it was decided to hold a bazaar on November 11th, 12th, and 13th, for the purpose of extinguishing it. The opening address was given by Mr. W. T. Paton, Esq., who, in declaring the bazaar open, expressed the sympathy he felt with the efforts of those who

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had promoted it. He had a strong admiration for that German writer who said, "I hope I shall never be so much of a man as to have none of the boy about me." It seemed as if all his life was cast among boys, and he was able to say that every effort he had made for young life, either in this parish or out of it, had been repaid three-hundredfold. (Cheers.) It was a remarkable fact that this institution had had its first origin in a quarrel amongst four telegraph messengers, which was amicably settled by the honorary secretary, Mr. F. C. Bourne, who afterwards conceived the idea of forming telegraph boys into a brotherhood, which should aim at their improvement religiously and socially, and aid their advancement in life. What was required was, that institutions which sought to make the younger generation good and useful members of society should be supported, and any assistance which they might give to so good a work would be rewarded both in this life and hereafter. (Hear, hear.)

The general arrangements of the bazaar were superintended by the honorary secretaries, Messrs. F. C. Bourne, S. H. Langham, and J. O. Baxter. The little hall was well filled with stalls stocked with fancy articles, and presided over by Miss Langham, the Misses West, the Misses Charles, the Misses Sansom, the Misses Nicholl, Miss Shaw, Miss Tailby, Miss Milne, and Miss Bourne. Mrs. Sturgess, the matron of the Northern Postal Telegraph Office, and who takes much interest in the Institute, and greatly encourages the boys, took charge of the woolwork division. We are glad to be able to add that the enterprise was a thorough success; the debt, after paying all expenses, has been wiped out, and a balance of £5 left in hand.

HOWELL'S IMPROVED BATTERY.

THIS battery is shown by the figure. It consists of an outer jar of stoneware or glass. Inside this jar is placed a cell or tube B, either with or without a bottom; this cell or tube, which is termed the "separator," is made with a number of narrow slots or openings in it in the direction of its length, the slots being of sufficient width to allow free passage of any fluid, but not so wide as to allow much of a mixture (which will be referred to further on) in the compartment A^1 formed by the outer jar, to pass through. The "separator," which rests upon the bottom of the outer jar and extends to the same height, may be made of stoneware or glass.

Inside the "separator" is placed an ordinary porous cell C, thus forming altogether three compartments.

In the outer compartment, or the compartment formed by the outer jar and "separator," is placed an ordinary plate or rod of carbon N, having the usual terminal for connecting purposes firmly attached to the top.

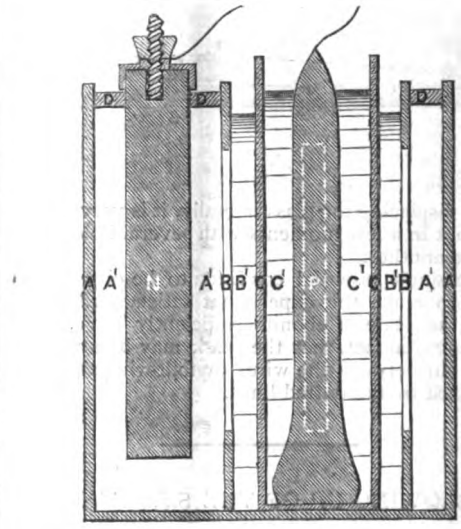
Surrounding the carbon or graphite plate and the "separator" is placed a mixture made up of ordinary peroxide of manganese or broken charcoal or graphite, also a quantity of sulphate of manganese (known commercially as white manganese).

For safety in transit, the mixture, as at D, may be sealed up with some suitable compound, such as marine glue or pitch, in which are made perforations to admit of the escape of gases, which perforations will also admit of a supply of saturated manganese being poured into the outer compartment when the battery is found to be weakening.

In the middle compartment B^1, formed by the slotted "separator" and the porous cell above mentioned, is placed a solution of sulphuric acid and water, which penetrates the slots in the "separator," and impregnates the mixture of manganese and carbon.

For the positive electrode, in the porous cell or inner compartment, a rod or plate of zinc P is placed.

This rod or plate of zinc is amalgamated with mercury, and a small quantity of the latter is placed in the porous cell to keep up the amalgamation.



In compartment C^1 of the porous cell C, containing the zinc rod or plate, is placed a solution of hydro-sulphate of ammonia and water.

The advantages of the whole arrangement of the improved galvanic battery are the following:—It has greater electro motive force, and retains the same for a more lengthened period (when worked under the same conditions) than any other form of peroxide of manganese and ammonia battery; it also admits of the removal of the porous cell for cleaning purposes without disturbing the mixture in the outer compartment, or compartment formed by the "separator" and the outer jar, so that salts may be removed, and the zinc amalgamated readily.

The mixture of peroxide of manganese with the sulphate of manganese has a higher conducting power than the peroxide alone; consequently, the resistance of the battery is very low.

WE purpose in an early issue to commence a series of articles fully descriptive of the apparatus and *matériel* employed by the British Postal Telegraph Department.

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LONTIN'S INCANDESCENT WIRE LAMP.

By G. E. HOSPITALIER.

ELECTRIC lighting by incandescence, although more relatively costly than lighting by the voltaic arc, nevertheless possesses certain advantages which recommend it for certain special purposes.

The greatest obstacle which up to the present has stood in the way of this method of illumination, has existed in the difficulty of preventing the fusion of the incandescent wire by an excess of current caused by an increase in the velocity of the Gramme machine, or from other causes.

M. Lontin has solved the problem in a very elegant manner by the regulator shown by Fig. 1.

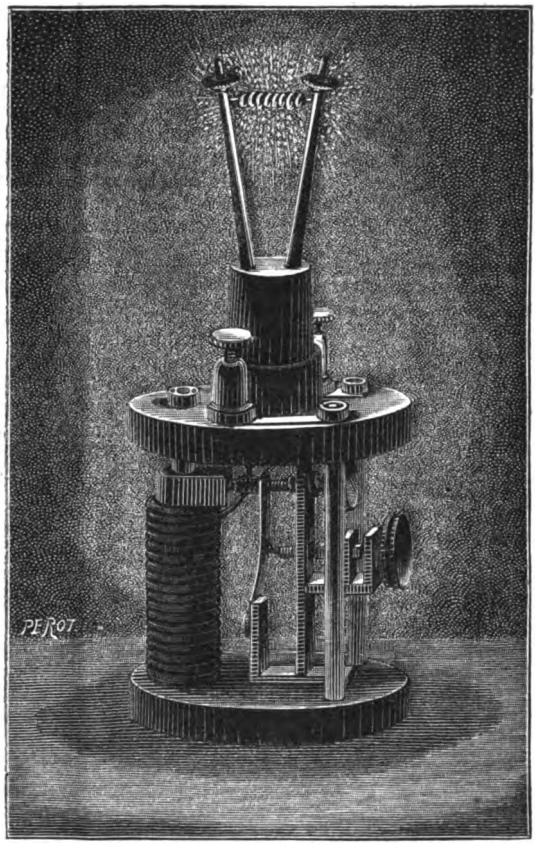

FIG. 1.

The current enters by one of the terminals of the lamp, traverses direct the wire of an electro-magnet, and then passes through the wire spiral which is to be heated by the current, and thence passes back to the generator by a second terminal.

The terminal at which the current enters is also connected with the iron core of the electro-magnet and the terminal at which the current leaves is connected with a little vertical spring, carrying at its upper extremity a small armature placed opposite the pole of the magnet. A small antagonistic spring, which can have its tension regulated by means of a thumbscrew, enables the vertical spring to resist more or less the pull of the electro-magnet.

So long as the current only attains a certain strength, the little armature fixed at the top of the vertical spring remains unattracted by the electro-magnet, but if the current exceeds this strength, the electro-magnet attracts the armature until it makes contact with the pole of the former. It thus establishes a direct route for the current, which then traverses the iron core of the electro-magnet direct, and allows but a very small portion to pass through its coils; in fact, short-circuits the electro-magnet, and also the wire spiral, which is thus prevented from

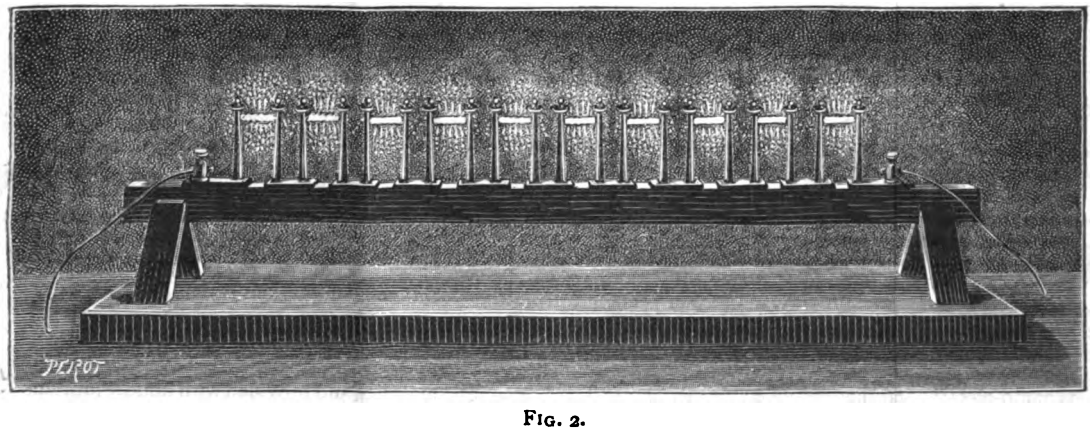

FIG. 2.

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fusing. The electro-magnet, being short-circuited, loses its attractive power, and ceases to attract the vertical spring, which latter falls away from the pole of the electro-magnet, thereby again allowing the current to traverse the spiral wire and the electro-magnet. By this means, then, if the regulating spring be strained up to any particular tension, the requisite amount of current can be made to flow through the platinum wire.

A single regulator can serve several lamps at the same time, as shown by Fig. 2, which shows a chain of 10 wire spirals, maintained at any required temperature by means of the regulator described. The 10 lamps are shown as joined up in series in the same circuit. The spirals are made of platinum wire, one millimetre in diameter. The total length of wire in these 10 spirals is 2½ metres approximately, though the total length of the spirals themselves is of course less. It is possible to keep 12 spirals, like those shown, incandescent by employing an 8-bobbin Lontin machine. With a 24-bobbin machine, 36 spirals can be kept luminous, and thus produce 36 lights.

The arrangement is a sensible advance towards effecting the sub-division of the electric light. Photometric experiments will show if there is a real gain in thus pushing so far a division which, up to the present, has been so unfavourable to electricity as a means of light. We must give M. Lontin the credit of having proved the *possibility* of sub-dividing the light; the day is, perhaps, not far distant when it will also be *economical.—La Nature.*

ELPHINSTONE AND VINCENT'S DYNAMO-ELECTRIC MACHINE.

THE object of this invention is to obtain electric currents with a less expenditure of motive force than has hitherto been required in working dynamo-electric and magneto-electric machines. To this end an arrangement of rotating coils is employed, so applied as to cut the lines of magnetic force, and thereby induce in the coils powerful currents of electricity, which may be used as intensity or as quantity currents.

Fig. 1 is a transverse vertical sectional view; and Fig. 2, a longitudinal vertical section taken through the centre of the machine. In these Figs., A, A, are two standards connected together by the bridges B, B, B, so as to form the framing of the machine. Mounted in bearings in the standards A, A, is a hollow drum C, made of brass or some other non-magnetic material, and provided with hollow journals *c*, *c*, which project from the closed ends of the drum. Upon one of these journals, and external of the framing, is keyed a driving pulley D. On the outer periphery of this drum any suitable number of coils of insulated copper wire E, E, is placed.

The method of laying the coils will be better

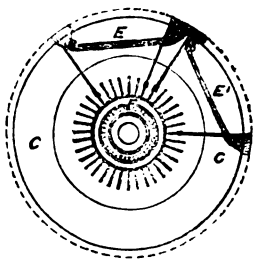

FIG. 3

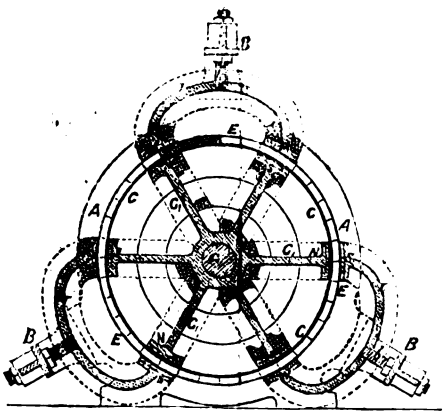

FIG. 1.

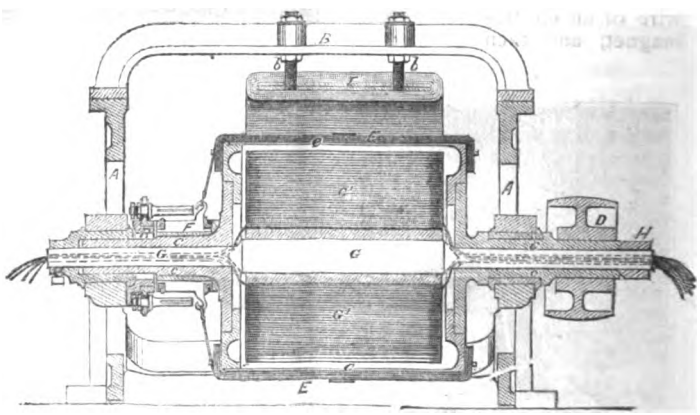

FIG 2.

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understood by referring to Fig. 3, which represents an end view of the drum and commutator detached, and with two coils placed on it. The wires forming these coils are laid parallel with the axis of the drum from end to end, and over the ends or heads of it, E representing the end of one coil, and E^1 the end of another coil, the free ends of each coil being connected with a commutator F.

By this mode of forming the armature coils, a large proportion of the wire is rendered efficient, and the amount of useless internal resistance is consequently reduced.

Mounted upon a dead shaft G, which passes through the hollow journals of the drum C, is an electro-magnet G^1. This magnet is formed of pairs of radial plates of soft iron, which stand out from the central axis, and are each wound around with insulated copper wire from end to end, as shown in the Fig., and in such a manner as to ensure that upon the passage of a current of electricity through the wire, their outer extremities will become alternately of north and south polarity, as indicated by the letters N and S (which mode of winding is well understood by electricians). The terminals of these wires are brought out through grooves or holes formed longitudinally through or upon the ends of the shaft G, which is kept from rotating with the drum C by means of the bridge piece H, to which it is secured by set screws or otherwise.

Outside the drum C, and in close proximity to it, are placed three electro-magnets I, I, I. These magnets are secured to the bridge B, B, of the main frame by the bolts and nuts *b b*, by which they can be adjusted, and they are so placed with respect to the radial plates of the magnet G^1 that their poles are opposed to the poles of the magnet G^1.

The magnets I, I, I, are wound with insulated wire in such a direction that upon the passage of the current their poles will be in opposition to the poles of the magnet G^1, as indicated by the letters N, S. The commutator F is formed of thin plates of metal placed radially around the hollow journal of the drum C, and insulated from each other and from the journal by vulcanite or other suitable material. The brushes for collecting the induced currents are carried by a ring K, secured to the main frame of the machine, but insulated from it; they do not possess any special feature above those ordinarily employed for such purposes.

EDISON'S ELECTRICAL GENERATOR.

By CHARLES A. SEELEY, PH.D.

ELECTRIC machines convert mechanical into electrical energy. The obtaining of electricity may be considered a manufacturing process, wherein steam power is the raw material and electricity the product. The best machine, other things being equal, will give the greatest yield of finished product from a given expenditure or consumption of raw material. The ratio of yield to consumption is the expression of the efficiency of the machine.

How many foot pounds of electricity can be got out of 100 foot pounds of mechanical energy? Certainly not more than 100; certainly less. What are the sources of loss, and what become of the lost foot pounds? Friction and resistance of the air inexorably demand their share in all kinds of machines. In the electric machine a heavy armature, sometimes spread out like a fanning mill, must be revolved at the rate of 500 or 1,000 times in a minute. Also, there are great leakages incidental and peculiar to the electric machine, which may be summed up in the expression local actions, which consist in currents induced outside of the normal circuit, changes in the magnetism of the magnet cores, &c. How many foot pounds do we lose, or are we obliged to lose, out of the 100 expended? How many foot pounds of electricity are left after deducting the losses? The facts and laws of physics, with the assistance of mathematical logic, never fail to furnish precious answers to such questions. People generally, however, are not familiar with the methods and language of exact science, and prefer results of direct, plain, actual, and practical experiments, results unmixed with any abstraction. We appeal now to the testimony of such experiments.

In 1877 a committee of the Franklin Institute, consisting of ten competent and eminent experts, with a view of determining the capabilities of electrical generators, made a series of trials with the best machines then procurable. Their elaborate report, describing the details of experiments, was published in the May and June Institute *Journal* of 1878. This report has become a recognised authority, and remains, so far as I know, in all respects unimpeached; and I shall use it now with fullest confidence in the accuracy of its statements. The committee experimented with six machines: three Brush, two Wallace, one Gramme. To suit my present purpose, I have reduced statements of the report to the simple symmetrical form of the table below. This table shows the losses and produce of 100 foot pounds of power delivered upon each machine; the figures may be read as representing foot pounds or per cents.

1	2	3	4	5	6
a. Brush	16·7	33·5	50·1	50·	31·
b. ,,	10·4	50·9	61·1	39·	22·
c. ,,	11·1	41·	52·1	47·	27·
d. Wallace	8·	53·2	58·2	38·1	14·
e. ,,	8·6	63·	71·6	30·3	12·
f. Gramme	7·4	21·	28·4	71·9	38·

1. Names of machines.
2. Friction and resistance of the air.
3. Local actions, including all losses, except those of 2.
4. Total losses, the sum of 2 and 3.
5. Total current of the normal circuit, or the total yield of electricity.
6. The electricity utilised in producing light. It is substantially the amount utilisable for any purpose.

I present this table as worthy of thoughtful attention; it should interest all electricians. The facts which a little study will disclose may prove somewhat appalling to those whose imaginations have been busy with bringing Niagara power to New York, and with the demolition of gas companies.

The facts shown in columns 5 and 6 are worthy of special attention. The total produce of electricity is shown in 5, and in 6 the practical value of that electricity; the figures in 6 are only about one-half the corresponding figures of 5. Why is it that when we have produced the electricity half of it must slip

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away? Some persons will be content if they are told simply that it is a way which electricity has of behaving. But there is a satisfactory, rational explanation, which, I believe, can be made plain to persons of ordinary intelligence. It ought to be known to all those who are making or using machines. I am grieved to observe that many persons who talk and write glibly about electricity do not understand it; some even ignore or deny the fact to be explained. I will try to set forth the case plainly.

Electricity moves in a circuit, and in moving disappears; that is, it is converted into some other form of energy. The same electricity does not move round and round again; it never repasses the starting-point; it does not exist to repass the starting point. As it moves it falls and dies in its tracks, and its dead body at once and on the spot is resurrected, but in a changed form. Now a part of the circuit is always and of necessity inside of the machine or battery; it is the wire of the armature or the liquids and the metals of the battery. This part of the circuit also is inaccessible, and the electricity which is here transformed is unavailable; this electricity, in fact, is worse than useless, for the heat into which it is transformed is one of the serious practical difficulties of the machine. It is then only the electricity which appears in the circuit outside of the machine which is utilisable.

At this point plausibly comes in a suggestion that the internal part of the circuit be made very small and the external part very large. Why not (say) make the internal part 1 and the external 9, thus saving nine-tenths, and losing only one-tenth? Unfortunately the suggestion is not practical; a fallacy is concealed in it.

The electricity is truly converted throughout the entire circuit, but not evenly in proportion to the length of the circuit. The conversion takes place precisely and exactly in accord with the resistance in the circuit to the flow of the electricity. The electricity may be considered as distributed over the whole circuit *pari passu* with the resistance, and thereupon is transformed into energy of another name, distributed as to the quantity precisely as was the electricity. This explanation does not disclose the weakness of the suggestion, but it will assist us in finding it.

Beasts of burden and other rational creatures redouble their efforts when their burdens are increased, and "thrice is he armed," &c. Electricity behaves very differently; there are no moral suasions or reserved forces behind it. Increase its burden, and it weakens right down; it is more stubborn than a mule; it won't budge at all, except after its narrow plan. The law of the electric current is that it exists or is produced *inversely* as the resistance to its flow in the circuit; double the resistance and the current is halved; treble the resistance and the current is one-third, &c. In any machine let the armature revolve steadily, and the current produced will depend solely upon the resistance; with the least resistance you get the maximum current, with the greatest resistance you have the minimum current. Now, also, the internal resistance of any machine is constant or unalterable. In order to get any external effect, external resistance must be added to the internal. To get the greatest yield from a machine or battery, it must be short-circuited; that is, the external resistance must be suppressed; but then you find yourself in the interesting predicament that all the electricity is securely bottled up in the armature, and is of no good to you. On the other hand, arrange things so that the greatest part of the resistance is external, and the electricity has shrivelled up to a quantity which is utterly useless to any allopath. There is evidently a just mean; what is it? What is the best practical ratio of the external and internal resistance? The mathematical calculations which clearly and beautifully answer this question, and which take in the principle that the sum of variables is least when they are equal, are probably beyond the experience of the average reader, and I substitute a sort of cut and dry method.

Let the current of the short circuited machine be (say) 100. Now add an external resistance (R″) equal to the internal (r), thereby making a doubled total resistance (R). ($r + R' = R$). The total current has become 50, and the external or utilisable part of it is 25. Treble the R, making $r = 1$ and $R' = 2$, and the total current becomes 33⅓ and the utilisable part 22·2. For another trial, make external half as great as internal $r = 1$, and $R' = \frac{1}{2}$, and total current becomes 66·6, of which 22·2 is utilisable. Now we are getting indications of the fact that the greatest external current is produced *in a given time* when the external and internal resistances are equal. I recommend the reader who is not yet satisfied to continue the cut and dry plan till he shall be.

But, exclaims the bright scholar who is always on the *qui vive* for flaws, it is a question of economy, and it may be best to take a little more than the given time, and so get a greater portion than the half for our use; time is cheaper than coal; or, if we must have a certain great quantity of electricity in a short time, we may build a very big machine or use a good many little ones; why not save nine-tenths of the total current? The remarks of the bright scholar are always entertaining, sometimes they are instructive. The trouble with him is that, although his vision is very clear, it is not so wide; he is quick to spy out a thing, but he does not observe its environments. Why not nine-tenths? It is a hard thing to do after perusing the table of results above given; but consider or imagine that the losses of a machine by friction and local action are reduced to one-tenth, so that 100 foot pounds of steam-power produce 90 foot pounds of current, of which the external part of the circuit (= to the internal) shall have 45. Now adjust external resistance so that you shall get nine-tenths outside and one-tenth inside, and weigh and figure up the results. Instead of getting 9 for 10 invested, you have 16·2 avails of 28 invested, or at the rate of 5·8 from 10 invested. There is a clear gain by attending to the spigot, but the steady leakage at the bung was still going on. I do not mean to say that the equalising r and R′ should be an inflexible practical rule, but simply that the advantages of varying from it are not so great as some persons suppose; also the loss from local action is not constant for varying products of electricity; the illustration ought not to mislead any one, and the precise data for determining the peculiar ratio of r to R′ for the most economical working are plainly enough indicated.—*Scientific American.*

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DR. AGER'S TELEGRAM CODE.

SOME few weeks ago a favourable notice, we believe from the pen of Sir James Anderson, was given in a contemporary of the above code, which was then about passing through the press. Since that time, in the same journal, a letter has appeared from the worthy secretary of the Eastern Telegraph Company, and also a paragraph respecting the same subject. Dr. Ager has replied by a circular letter, a copy of which has been handed to us, and, in justice to the Doctor, we append the principal portions thereof. The code, we hear, is selling well, and we congratulate Dr. Ager on the fact, for if hard work and the use of great ability and intelligence in the attainment of an object deserve success, then does that gentleman well merit all he obtains.

DEAR SIR,—The extraordinary action of the Eastern Telegraph Company in publishing a circular respecting *The Standard Telegram Code* renders it incumbent upon me to issue a reply, in order to correct some of the misstatements contained in that circular.

My counter-statement is a simple one—simple as truth usually is—and I venture to think that every act of the Eastern Telegraph Company, down to their last, may be adduced in support of my statement.

Late in July last I received an invitation to meet Sir James Anderson, who had, I was informed, decided upon the joint publication by the Telegraph Companies of an authorised code, to be compiled by me.

In response to this invitation, I met Sir James Anderson, and stated to him the terms upon which I would engage to compile a code of 100,000 words, to be chosen from 170,000, which I had been collecting during the last three or four years. Sir James Anderson thought my terms too high, but he, nevertheless, advised me to proceed with the compilation. About a month or six weeks later, *i.e.*, after Sir James had taken his holiday, I received a second invitation to call upon him.

At this interview it was definitely arranged that I should publish the work, under the patronage of the Eastern Telegraph Company, and I promised to submit to Sir James Anderson, from time to time, proofs of the code (I use his exact words), "In order that I may be able to say that I have seen it during its compilation."

The matter was fully—very fully—discussed by us. I informed Sir James Anderson that over 25,000 of the 100,000 words were in print. Moreover, I informed him as to who was printing the work, and he reproached me for not having given it to a printer whom he named.

No single word was uttered about my submitting the proofs to the telegraphic companies for the purpose of revision, or I should have found it necessary to mention a former experience when a telegraph official undertook to revise my code words, and passed a considerable number of duplicate words.

As 25,000 words were in type at the time this agreement was made, any supervision of the work would necessarily have been but partial, and I venture to ask candid logicians to compare my statement and that lately put forward by the Eastern Telegraph Company, with the notice of the work sent through Sir James Anderson, and published on October 11th.

I lost no time in submitting to the Eastern Telegraph Company a series of proofs that chanced to be then in hand.

Of the description of these given in the Eastern Telegraph Company's circular, I have, I think, most right to complain. They remark "That these were much objected to."

Coming from a telegraph company, these words may well be supposed to convey the indictment that the code words I submitted were unsuitable for telegraph purposes; whereas the the only substantiated objection to them was their *length*. (In truth, as these words commenced with "Col," "Com," "Con," they were, as every linguist knows almost all such words to be, somewhat long.) Moreover, the fact is suppressed that the words in this selection *were commended for their liquid character*.

The first proofs sent were returned to me after about a month or five weeks, when I sent, as per agreement, another set. These I have not yet received, and have therefore not sent any more.

To have made the completion of this work dependent upon the action of the Eastern Telegraph Company would, according to their own statement of the agreement between us, have delayed the publication of *The Standard Telegram Code* until very near the time appointed for the next conference (1884).

My position, for a long time a mystery to me, is now well defined—I am no worse off than other code makers; and, knowing as I do the qualifications of my staff and their zeal to secure accuracy, I feel inclined to consider myself better off than others. I have collected 100,000 genuine words so liquid in character as greatly to reduce the chances of mutilation, and with such a fair alternation of long and short words as will render detection easier when errors occur; and as I have had many proofs of Sir James Anderson's anxiety to facilitate telegraphic communication, I am not without a hope that the Eastern Telegraph Company will return to the agreement as at first made between us; but should I be disappointed in this, I appeal to the mercantile world to do me the justice denied me in other quarters. The words have been compiled in *strict accordance with the London Convention Rules*, and I have in my preface renewed the promise to exercise a continued vigilance as to the elimination of unsuitable words, and to provide an easy and efficient method of correcting such as I may hereafter discover or those that may be pointed out to me.

The book is now published and ready for delivery.

I am, dear Sir, very faithfully yours,

GEO. AGER.

50, Wellington Road, Stoke Newington, N.
Nov. 25, 1879.

Notes.

PNEUMATIC TELEGRAPHS IN PARIS.—A portion of the pneumatic telegraph system, which is intended to supersede the electric, as far as the local system in Paris is concerned, is now in working order. The "carriers," which contain the messages, and which are driven through tubes by pneumatic pressure, are of leather, and contain a number of tin boxes in which the messages are packed. Each box takes 30 message forms, and 12 to 15 of the boxes are placed in a row in the "carrier." Every box is marked with a letter indicating its destination. Several receiving offices are at intermediate places on the route of the tubes, and from these offices as the boxes containing the messages are received, the messages are despatched to their destination by messengers. A disadvantage of the pneumatic system in place of an electric exists in the fact that the number

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of despatching and receiving offices must necessarily be limited, as, if a number of small offices, such as exist in London, were served by a pneumatic system, the expense of the plant would be enormous. In London, a pneumatic system, as a supplement to the electric, is found to be of great value, and is extensively employed.

STATUE OF GALVANI.—On Sunday, November 9th, a statue of Galvani, in the act of touching with two different metals the lumbar nerves of a frog, was dedicated at Bologna, his native city.

THE BELL AND EDISON TELEPHONES.—The Edison Telephone Company are bringing an action against the Bell Telephone Company for infringement of patent; the action has reference to the Blake transmitter, of which a description was published in the number of this Journal for October 1st, 1879.

CABLE REPAIRING.—In the repair of the Bilbao-Lizard cable by the Silvertown Telegraph Works Company, which was effected recently, an instance was afforded of the extraordinary accuracy with which the locality of a fault can be detected by testing. The repairing ship having grappled the cable at the point indicated by the test, and raised it to the surface, the fault was found to be only *fourteen fathoms* off from the point where the grapnel had hooked the cable.

SIGNALLING BY ILLUMINATED STEAM.—A novel method of signalling was recently tried at Blackwall by the Trinity Brethren. The apparatus is the invention of Mr. Carl O. Ramstedt, and consists of a dished chamber, in which is burnt coloured fire. The flare produced is reflected by means of a reflector on escaping steam, which it illuminates; by flashing the light on the steam in flashes of long and short duration the usual signals can be transmitted. It is stated that the illuminated steam can be seen at a considerable distance.

THE TELEPHONE IN MINES.—A trial has been made of Edison's telephone in the Wheal Uly Mine, Cornwall. One instrument was placed in the account house and the other at the adit level, 26 fathoms below the surface of the ground. The trial was satisfactory, as conversation could be carried on, in spite of the noise made by the stamps near the account house, and the splashing of water in the adit.

THE ELECTRIC LIGHT is being introduced into several of the Lake Superior iron mines.

THE TELEGRAPH IN JAVA AND SUMATRA.—The Dutch have established telegraph lines in their possessions in Java and Sumatra. The construction of these lines has been very difficult, in consequence of the wildness of the country through which they pass. Elephants, tigers, bears, and buffaloes were a source of continual danger to the inspectors and linemen who patrolled the lines. Monkeys, both large and small, seemed to consider that the lines were specially erected for their gymnastic exercises, and they continually broke the wires by hanging to them in great numbers.

THE NEW FRENCH ATLANTIC CABLE.—The cable of La Compagnie Française du Télégraphe de Paris à New York was formally inaugurated on the 20th ult. by President Grévy sending a telegram to President Hayes, expressing the most cordial sentiments towards the President of the United States. Mr. Cornell Jewett's threatened opposition to the landing of the cable has come, as we anticipated it would, to naught, and the company having previously placed extensive orders in this country for telegraph wires, have rapidly connected the shore end with New York. The *Faraday* will lay the Cable between St. Pierre and Torbay before returning, and afterwards it will probably be considered desirable to again despatch her to connect, by a branch cable, Brest with the G.P.O. wires at the Land's End.

MAGPIES AND THE TELEGRAPH.—A curious cause of interruption, says the *Journal of the Melbourne Telegraph Electrical Society*, occurred lately on two of the Western lines, Australia. An intermittent "cross," one of the most troublesome of faults to detect, existed for some little time on these lines, and a close inspection was found to be necessary. This resulted in the discovery that some magpies (Australian) had actually built a nest on one of the telegraph poles, and, among other materials used in its construction, had taken all the odd pieces of tie-wire which they could find within some distance of the spot: scraps which had been thrown aside by the line-repairers were twisted up together in the most singular manner, considering that they had no "plyers" to work with excepting their beaks. Some of these pieces of wire touched one line and some occasionally the other, causing the "cross" complained of. It appears that lately several attempts at nest-building on the part of magpies have taken place on telegraph poles on the plains in the Western District.

AN OBSERVATORY ON MOUNT ÆTNA.—It is intended shortly to erect on Mount Ætna an observatory for meteorological, astronomical and seismological purposes; it will be 9,652 feet above the sea-level, and will be the second highest observatory in the world. The purity of the atmosphere is so great at the place that the naked eye acquires a power of vision which can be exercised elsewhere by means of a small telescope, whilst the planet Venus casts a perceptible shadow.

THE papers of the late Professor Clark Maxwell will be arranged and published by Professor Stokes, who is one of the executors.

A NEW THERMOMETER.—M. Debsun has lately brought before the French Academy an electric-capillary thermometer; the instrument is formed of an ordinary fine thermometer tube filled with acidulated water; a chain of drops of mercury are also placed in the tube, the first and last drops being connected with platinum wires at the ends of the tube. When the acidulated water is dilated by increase of temperature the globules of mercury are changed in shape, this causes a current of electricity to flow, the strength of which current is proportional to the dilation of the acidulated water. The current so generated may be observed on a Lippman electrometer; the apparatus is said to be very sensitive.

A COMPACT form of Gramme machine has been constructed for Professor Stefsan, of Vienna, by M. Niaudet. In this apparatus the permanent steel magnets are of a circular form, and the cheeks, which embrace the revolving armature, are of a novel shape.

THE RONALD'S LIBRARY.—The binding of the books which form this library is now being proceeded with, under the supervision of Mr. A. J. Frost. It may be remembered that the conditions under which the library was to be held by the Society of Telegraph Engineers were that the books were to be bound at the society's

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expense. The surplus of the fund for entertaining the members of the Telegraph Conference, as we announced in our last number, having enabled this to be done, it is satisfactory to know that the work is progressing, and that the library will be secured to the society.

THE medals awarded and recommended by the Council of the Royal Society for the present year are:—The Copley Medal to Professor Rudolph J. E. Clamins, of Rome, for his researches upon heat; the Davey Medal to M. P. E. Lecoq de Boisbandran, for his discovery of gallium; a Royal Medal to Mr. William Henry Perkins, F.R.S., for his long-continued and successful labours in geology and physical geography.

THE phenomena of evaporation and distillation, under the influence of electrification, has lately been studied by M. Gernez. The liquid under test is placed in an inverted U-shaped tube, so that liquid is present in either limb and at the same level. Sparks from a Holtz machine are passed across the bend, which is clear of liquid, and it is found that this causes the liquid to distil, as it were, over into the other. Pure alcohol distils over three times as fast as water, but a mixture of the two at a less rate than the latter. The addition of a soluble salt increases the rate of distillation. Some liquids, such as bi-sulphide of carbon, or turpentine, do not exhibit the phenomena.

TELEGRAPHIC communication with Cabul was completed on the 21st ult.

THE ELECTRIC LIGHT AT THE BRITISH MUSEUM.—For more than a century readers at the British Museum have been obliged to suspend their labours on occasions when the vagaries of our temperate climate have been more than usually wild. On Saturday morning, shortly after 10 o'clock, many readers, following previous traditions, were about to cease their labours on account of the impossibility of making their eyes and the figures on the books meet, the dense fog which reigned having completely got the mastery. Messrs. Siemens, however, were quite equal to the occasion, and quite unexpectedly the spacious room was illuminated as by magic, to the great satisfaction of all present. Several improvements have taken place in the apparatus since it was first put in action for the Museum. The reflectors of the lamps, at the suggestion of Mr. Bond, the principal librarian, have been gilt instead of silvered, thus taking off somewhat from the coldness of the light, and making it more like sun than moonlight. There can be no doubt about the perfect success of the illumination.

M. J. VIOLLE, in "Comptes Rendus," says: "The specific heat of iridium, like that of platinum, increases regularly with the temperature. The mean specific heat varies little up to 600°, and then increases sensibly on approaching the melting point." The melting points given are:—Silver, 954°; gold, 1,035°; copper, 1,054°; palladium, 1,500°; platinum, 1,775°; iridium, 1,950°.

THE American *Operator* says: "The Western Union has been very unfortunate in its law-suits lately. In addition to the Colgate and the telephone cases, every suit it brought against the American Union has been decided in favour of the latter company, while the only case brought by the American Union against it—a motion for an injunction in the New York Central matter—has been granted."

MR. HENRY W. POPE has resigned his position of General Superintendent of the American District Telegraph Company, and accepted a similar one with the National Bell Telephone Company, New York.

THE Bell Telephone Company, of America, and the American Speaking Telephone Company have, after much litigation and considerable negotiation, at last amicably arranged their little difficulty. As the agreement, which is very voluminous, was not signed when the mail left, the contents could not be ascertained.

WE hear that the Edison Telephone Company are launching exchanges in Cornhill, in Eastcheap, in Westminster, in Chancery Lane, and in St. James's.

MR. EDISON has announced by telegram that he has modified his telephone, by substituting for the manual turning of the chalk cylinder an automatic apparatus which, having been wound up, will supply the necessary friction, and thus leave the operator free to write from dictation, to take shorthand notes, or *to set up type*. (?)

IMPROVED TELEGRAPH WIRE.—To produce telegraph or other wire of high and uniform quality, of high electrical conductivity, and capable of withstanding a high tensional and torsional strain, Mr. Cooke, of Rotherham, has patented an invention which consists in reducing the quantity of carbon, silicon, sulphur, and maganese existing in common metal, to the relative proportions in which they exist in best iron. He first produces, by ordinary means, and in ordinary apparatus, a metal containing:—Iron, 99·753; carbon, 0·450; silicon, 0·077; sulphur, 0·070; and manganese, 0·890. This metal, or metallic alloy, he cuts into small pieces and places in a furnace, and surrounds it with charcoal, and subjects it to one or more currents of atmospheric air, by which means it is melted, the action of the air and charcoal upon the metal, or metallic alloy, being continued until the elements in excess are reduced to the proper proportions to ensure the iron being of the quality specified. The mass of fused iron is balled up, and forged and manipulated in the ordinary way.

MR. L. SCHWENDLER, in a paper published in the *Journal* of the Asiatic Society of Bengal, says: "It appears that light by *incandescence* is scarcely any cheaper than light by *combustion*. The reason of this is that the temperature of an incandescent platinum wire is not very much higher than the temperature of a flame, and that for unit volume the mass, which has to be kept heated in a piece of platinum, is much larger than the mass in a flame. Unless we should be fortunate enough to discover a conductor of electricity with a much higher melting-point than platinum, and the specific weight and specific heat of which conductor is also much lower than for platinum, and which, at the same time, does not combine at high temperatures with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination."

CAPACITY OF VOLTAIC POLARISATION.—M. R. Blondot has measured the amount of electricity required to polarise the electrodes of a voltameter using a current of feeble electro-motive force. When the electro-motive force is low, there is an approximate relation between the charge and the electo-motive force of polarisation; when it is high, the charge increases more rapidly than the polarisation. For a given electrode and electrolyte the initial capacity does not depend on the kind of polarisation.

SEVERAL kinds of plants, according to Naudin, seem to flourish better if protected from the action of atmospheric electricity.

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SPECIFIC MAGNETISM OF IRON forms the subject of an essay by Dr. Auerbach, of Breslau. He shows that this is not without influence on the galvanic behaviour of the metal. If a current be conducted through an iron wire, phenomena appear which do not occur with other metals. The following are some of the known facts:—The actual galvanic conductivity has been variously stated between 12·35 and 15·9 per cent. Resistance increases with rise of temperature. The heat generated, by Joule's law, is 448·0, as against 478·9 for copper. On closing the circuit, an extra current takes place in the opposite direction; on opening, in the same direction. Longitudinal magnetisation of iron influences its resistance. In examining the last phenomenon, the great difficulty was to exclude the influence of temperature. An adiathermanous magnetising apparatus was made by winding the wire on a glass tube, into which a caoutchouc tube was introduced, with a smaller glass tube within it, the wire itself being wrapped in paper. Special arrangements were made also to reduce the intensity of the extra current. These due precautions having been observed, a large transient and a smaller permanent diminution of resistance was observed, the former amounting to 2 per cent.

CLAMOND'S THERMOPILE.—The pattern now in use for lighting a workshop in Paris is 2½ metres high, and one metre in diameter. Another model, made for exhibition at the Albert Hall, is square and smaller, though of the same power. Each half of the cylindrical battery can be made to supply a powerful electric light, while the square one can produce four lights of half the brilliancy. The E. M. F. is, according to prolonged experiments, 218 volts, about equal to 120 Bunsen cells, while the resistance is only 31 ohms. The large battery consumes 9 or 10 kilogrammes of coke per hour; the smaller about 6½ kilogrammes. The large external surface of the apparatus, radiating its heat to the air around, fits it for warming purposes as well as for lighting.

THE TEMPERATURE OF CARBONS GIVING THE ELECTRIC LIGHT has been examined by M. Rosetti, by means of a thermopile, the face of which is placed at a suitable distance to receive rays from a radiating surface of determinate size; the thermal effect being measured by a sensitive reflecting galvanometer. He comes to the conclusions that (1) The positive pole has higher temperature than the negative. (2) The temperatures vary according to the intensity of the current. (3) They are higher the smaller the radiating surface, provided it comprises the extreme point. (4) In the negative pole, the minimum temperature was 1910° Cent., with a large radiating surface of small brilliancy; the maximum 2532° Cent., the radiating surface being half the preceding. (5) For the positive pole, the minimum temperature was 2312°, the carbon being large; the maximum 3200°, with a thin carbon and small radiating surface.

FROM experiments made by Dr. Carl Barus, he concludes that the thermo-electric position of steel progresses continuously with its degree of hardness, or, in other words, thermo-electric and mechanical hardness are functions one of another. Also that the specific resistance of steel increases continuously with its mechanical hardness.

THE TELEPHONE COMPANY.—The Telephone Company's Exchange is progressing; nearly 150 subscribers now have their places of business connected with the Exchange stations, which are three in number. The annual subscription for subscribers within a radius of a mile from the Exchange stations is £20 per annum.

THE "Edison Telephone Company" have opened offices at Royal Exchange Square, Glasgow; and the "Telephone Company" at 72, Queen Street, in the same town.

THE telegrams sent from the City (exclusive of the Stock Exchange) during the month of October last, as compared with October, 1878, have increased from 182,964 to 234,839, being an increase of 51,875, or about 28 per cent. From the Stock Exchange, the increase over the month of October in last year has been from 79,370 to 112,163, being an increase of 32,793, or about 41 per cent.

IN a series of experiments recently described to the Vienna Academy, Professor von Waltenhofen has sought to deduce the mechanical equivalent of heat by a direct measurement of the work done by an induced electric current in a closed circuit of given resistance. For this purpose, a magneto-electric machine was used, whose electro-motive force was ascertained to be proportional to the number of revolutions. The magneto machine was furnished with an arrangement for producing an indicator diagram showing the work done. The induced currents were measured by means of a tangent galvanometer. The results were found to be in satisfactory agreement with Joule's equivalent.

PROGRESS OF THE ELECTRIC LIGHT.—The Société Générale de l'Electricité has arranged with Messrs. Samuel Brothers, of Ludgate Hill, to light their warerooms with twelve Jablochkoff lights, and the counting-house with one, the whole to be driven from a 12-horse-power Otto gas engine. At the Creusot Iron Works, M. Schneider has contracted for the Jablochkoff light to be applied in the draughtsmen's office, and also to the fitting-shop. The Antwerp Basin was lit on the 14th ult. by the company. Following the example of their *confrères* of Antwerp, the municipality of Havre have extended the number of lights used by them from 12 to 52, and have contracted with the Société for ten years.

THE BALEARIC ISLANDS CABLE.—The submarine cable between Ivica and Majorca has been successfully completed, and the tests of it are perfect. This cable was manufactured for the Spanish Government by Mr. W. T. Henley, of North Woolwich, and sent out during the summer, but in consequence of the depth of water (500 fathoms) being twice as great as marked on the charts, and also owing to the cable being a very heavy one, so much slack had to be paid out that there was not sufficient to reach the landing-place by many miles. In this dilemma, Mr. Henley directed that the cable should be taken up again, which was done, and it was brought back to England, overhauled, and lengthened, and it has now been relaid with the expenditure of only one mile more cable than was first sent out.

MARCH *v.* TWEEDDALE, AND MACKINTOSH *v.* ANDERSON.—These actions were brought against Sir James Anderson, the Marquis of Tweeddale, Mr. George Cavendish-Bentinck, M.P., Lord A. Paget, Mr. P. Rawson, and Mr. C. E. Lewis, M.P., the object being to obtain a declaration that the holders of the preference and deferred certificates in an investment trust-fund were entitled to rank equally. In 1872 the defendants issued a prospectus inviting subscriptions for a share

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investment trust. They proposed to raise a capital of not less than £500,000 or more than £2,000,000 by £100 shares, each subscriber to receive £100 Six per Cent. Preference Certificates, redeemable from an accumulated sinking-fund of 1 per cent., by yearly drawings, at the price of 10 per cent., and also a £100 Deferred Certificate, which should entitle the holder to the surplus and ultimately to share in the trust-fund. The object in raising the money was to use it in prosecuting great industrial undertakings, such as submarine cables, tramways, iron and engineering works, and so on. A recent decision, however, ruled the investment company to be formed in contravention to the Lotteries Act. Mr. Davey, Q.C., Mr. Chitty, Q.C., Mr. Ince, Q.C., Mr. Romer, Mr. Alexander Young, and Mr. M'Laren appeared as council in the case. After some discussion, his lordship, with the consent of all parties, gave the same decision as in the case of "Lewis *v.* Cecil," which he decided last term, and ordered that the secretary should be confirmed in his office, for the purpose of winding-up the trust.

WE are glad to find that Colonel Reynolds has returned safe to England, and is looking well.

THE cable between Jamaica and Colon is repaired, and the cable between Antigua and Guadeloupe interrupted; as the St. Croix Trinidad cable is not yet repaired, there is at present no communication with Guadeloupe, Dominica, Martinique, St. Lucia, St. Vincent, Barbadoes, Grenada, Trinidad, Demerara, or Berbice.

Proceedings of Societies.

PHYSICAL SOCIETY.

AN Ordinary General Meeting of this Society was held on Nov. 22nd., Professor W. G. ADAMS in the chair. The following new members were proposed and elected:—Professor Reilly and Professor Heath, of Cooper's Hill Engineering College. Professor GUTHRIE then exhibited a new photometer in its crude form, and demonstrated its action to the meeting. It consists of two fixed plane mirrors, inclined to each other at an angle. The rays from the two sources of light to be compared are allowed to fall on these mirrors; those from one source, say that on the right-hand, falling on the right-hand mirror, and those from the left-hand source on the left-hand mirror. These rays are again reflected from the mirrors at right angles to their former paths and thrown upon a semi-transparent screen, where their relative densities can be compared by the eye of the observer. Between the mirror and each source of light a revolving shutter is interposed. These shutters are formed of brass discs, and they are both mounted on the same axis, which can be turned by the hand or otherwise. They would completely screen the light from the mirrors were it not that each is provided with four radial apertures, or slots, through which the rays can pass. The slots on the side, at which the bright source of light is placed, are narrower than those on which the weaker source is placed. The latter slots are made adjustable in size by sliding blinds, and a scale is added to measure the degree to which they are closed. On revolving the shutter the reflection of the rays to be compared, are seen side by side, and (owing to the persistence of images on the retina) continuously on the screen placed in front; and they are brought to equality of brightness by closing or opening the blinds of the adjustible shutter. When this is so, the rates of the respective orifices of the shutter, as given by the scale, is the ratio of the luminous intensities compared.

Professor ADAMS remarked that the speed of rotation should be such as to produce a uniform field of light on the screen, a result which hand-turning was not very conducive to.

Professor FOSTER, too, observed that the use of this new photometer might be less fatiguing to the eye than those photometers which presented a steady beam to the eye, undiluted with intervals of darkness, during which the light is cut off, as in the instrument before the meeting.

Professor REINHOLD then read a paper, by Professor RUCKER, of the Yorkshire College, Leeds, on "A Suggestion as to the Constitution of Chlorodine offered by the Dynamical theory of Gases." If a gas of density 8 consists of molecules, each of which posseses m degree of freedom, and if, also, the intermolecular forces are negligable, the specific heats at constant pressure ($c\,p$) and at constant volume ($c\,v$) are connected by the well-known equations:—

$$10\,(c\,p - c\,v)\,8 = \cdot0694$$

$$20\,\frac{c\,p}{c\,v} = 1 + \frac{2}{m+e}$$

Where e is a quantity which depends upon the potential energy of a molecule. Hence, if $c\,p$ is given by experiment, $c\,v$ can be calculated from the first equation, and then m and e are known from the second. Regnault determined the specific heats at constant pressure of 35 gases; and from the experiments of E. Weidemann and of Wullner, it appears that his values are correct within 6%, and that m and e can be calculated very closely from the above equations if $c\,p$ is given. One of the chief difficulties of the thermo-dynamic theory of gases has been to attribute to m and e values which would at once lead to the observed ratios of $c\,p$ and $c\,v$, and satisfy any rational supposition as to the interior mechanism of a molecule. Kundt and Warhng proved that for mercury $\frac{c\,p}{c\,v} = 1{\cdot}666$, which is consistent only with the supposition that the atoms o mercury are smooth, rigid spheres; and Boltzman and Bosanquet have pointed out that for a smooth, rigid surface of revolution $\frac{c\,p}{c\,v} = 1{\cdot}4$, a number agreeing closely with the experimental values for AW, O, N, H, C O and N O. The molecules of these gases may, therefore, be constituted of two spheres rigidly united, or as Mr. Rücker suggests, bound together by forces which prevent the separation of their surfaces while leaving them otherwise free to move. The principal object of Professor Rücker's paper was to point out an interesting fact connected with the application of this theory to chlorine. The maximum number of degrees of freedom which a molecule, composed of N smooth, rigid spheres, could possess, would be $3\,n$, but the forces in play between the spheres might reduce this number. Thus the value of $m + e$ could not exceed, but might be less than $3\,n + e$ when the molecule consists of two atoms, $e = o$, but for complex $c\,r$ molecules, $r\,c$ should—*caeteris paribus*—expect its value to increase with the number of molecules. From two tables of results calculated by him, Professor Rücker, however, finds that for a number of simple and complex gases and vapours the value of $m + e$ is for each substance less than $3\,n$ (or the maximum possible value of m); while for the majority of chlorine compounds examined, the reverse statement holds good, that is, the value of $m + e$ is generally greater than $3\,n$. This difference may be explained by supposing that for chlorine e is abnormally large; that the spheres are not necessarily

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in contact; or that n has been taken too small; that the symbol Cl_2 is incorrect, and that the chlorine atom contains a larger number of sub-atoms than has been supposed, a supposition which accords with the recent researches of Professor Victor Meyer on the vapour density of chlorine. Professor Rücker also finds that the ratio of the specific heats of bromine and one of its compounds studied ($C_2 H_2 Br$), agree with those of chlorine and the corresponding chlorine compounds.

Dr. SHETTLE, of Reading, then read a paper on the "Influence of Heat upon Certain Forms of Induction Coils, considered more especially in relation to the Inductive Power which the Blood exercises on the various Structures of the Body." The author found that when a copper and a zinc wire were insulated from each other by parchment paper and paraffined silk, and wound in close proximity to each other, an (induced) current was indicated on a galvanometer whose terminals were connected to the neighbouring ends of the zinc and copper wires respectively; the other ends being left free. When the latter were connected across, the deflection was *nil*. On raising the temperature of the two wires by causing hot water to flow inside the coil, into which they were wound, the deflection was largely increased. These experiments led Dr. Shettle to imagine that there is a similar action in the animal body. The heart is made up of nerves and muscular fibres, winding spirally, and some of these wind round each other so as to form a spiral cord, round which the blood capillaries also wind. Dr. Shettle compares these nerve and muscle bundles to the coils of zinc and copper wire in his experiments, and infers that electric currents may be induced in them as in the wires. The flow of the warm magnetic blood would also tend to produce currents in them. Dr. Shettle further drew attention to the fact that animals live and move in a magnetic field, and that electricity must be generated in them by their movements, internal and external.

Mr. EMMOTT exhibited Crossley's form of microphone, which consists of four short rods of carbon, jointed loosely with four blocks of carbon, so as to form a square. It is used as a transmitter for telephones; and Mr. Crossley regularly transmits the services of a church with it to several hearers. Its speaking, singing, and whistling powers were successfully demonstrated to the meeting.

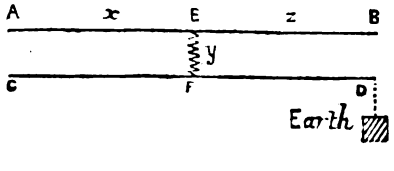
THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of this society, held Nov. 26th, Major BATEMAN-CHAMPAIN, R.E. (President), in the chair, the minutes of the last meeting having been read and confirmed, a paper by Mr. FELIX GAREY (foreign member) on "Condensers" was read. The paper being of a purely theoretical character, is not of sufficient interest to warrant a report being given here.

At the conclusion of the paper,

Professor HUGHES rose and expressed his surprise that a paper of such a purely theoretical character should have been brought before the meeting; he considered that it was only suited for publication in the proceedings of the society.

A paper by M. FEDELE CARDARELLI (foreign member) on "A Method of Localising a Contact between Two Telegraph Wires," was then read. The method is as follows:—



If A B, C D are the two wires which are in contact at the point y, then the end B of the wire A B is kept insulated, and the end C of the wire C D is also kept insulated, whilst the end D is put to earth. A resistance measurement R is then made from A, which gives the result,

$$R = x + y + z.$$

The end C is then joined to A, and a new measurement made: then the new resistance r is

$$r = z + \frac{(x+y)\,x}{x+y+x};$$

also if L be the resistance of the line, then

$$L = x + z,$$

by combining the three equations the result is obtained

$$x = L - r + \sqrt{(R-r)\,(L-r)}.$$

In the discussion which followed the reading of the paper,

Mr. KEMPE pointed out that the formula obtained was exactly the same as that for Blavier's well-known method of localising the position of an earth in a line.

New Patents—1879.

4405. "Electric lamps." A. V. NEWTON. (Communicated by F. Tommasi.) Dated October 29.

4549. "Insulated electric conductors." J. BELL. Dated November 8.

4555. "Improvements in and appertaining to electro-magnets." J. BELL. Dated November 8.

4572. "Conductors or cables for telephonic apparatus." W. R. LAKE. (Communicated by E. Holmes and E. T. Greenfeld.) Dated November 10.

4573. "Electric telegraph apparatus." C. D. ABEL. (Communicated by E. George.) Dated November 10.

4576. "Improvements in electric lamps, and in the method of manufacturing the same." T. A. EDISON. Dated Nov. 10.

4589. "Improvements in apparatus for generating electric currents, also in electric lamps, and in the manufacture of carbons to be used therewith, part of which improvements is applicable to electro-magnets generally." C. F. HEINRICHS. Dated November 11.

4590. "Apparatus and mechanism for electric lighting." G. P. HARDING. Dated November 11.

4593. "Electric signal or indicator apparatus." W. MOSELEY. Dated November 11.

4613. "A needle sounder." F. M. ROGERS. Dated November 13.

4653. "Improvements in the transmission of power by electricity, and in the apparatus employed therein." J. HOPKINSON. Dated November 14.

4696. "Electro-magnetic engines." A. M. CLARK. (Communicated by J. S. Laman.) Dated Nov. 18.

4708. "Improvements in, and connected with, electric bells; specially designed for signalling from the rooms of passenger ships and hotels, and for other purposes." J. WHITE. Dated November 19.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

1307. "Iron telegraph posts." FRANK WIRTH. Dated April 2. 2d. The post consists of a central bar of rolled iron, preferably about five metres long and thirty millimetres thick, and three rods of round rolled iron, preferably four metres long and thirteen millimetres thick. These rods are provided at the top with heads,

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and with slots, or recesses, into which the said rods are passed, and with projections on its upper surface, behind which the heads on the said rods rest when they ar placed in the said recesses.

1374. "Electric direction and pressure wind vanes." DAMPIER SEABROOK VERNON. Dated April 7. 2d. The apparatus consists of three parts, viz., the vane, the indicator, and the battery; and the object of it is to dispense with shafting.

1383. "Electric telegraph apparatus for transmitting orders on shipboard, &c." JAMES PITKIN. Dated April 7. 2d. This invention relates to an improved electric telegraph of exceedingly simple construction, for use on board ship, for transmitting orders from the bridge to the engine-room or helm. It consists of a dial bearing the usual words of command, a disc of insulated material placed beneath, carrying a circle of metallic contact pieces at uniform distances, a part connected to a central plate, and a pair of contact springs, insulated and placed diametrically opposite one another in the parts of the contact pieces on the disc, and connected respectively to the two portions of the battery circuit in which the instrument is placed. The disc is rotated by a handle working over the dial, and at each passage of an opposite pair of contact pieces, or of the alternate spaces over the contact springs, the circuit is completed or broken, the completion of the circuit corresponding with the passage of the handle from one division of the dial to another. The indicator comprises a similar dial, with a pointer having an escapement wheel on its axis, actuated by a pallet on an arm or extension, carried by the armature of an electro-magnet in the circuit.

1387. "Dynamo and magneto-electric machines for lighting, plating, &c." ARTHUR WELLESLEY LAKE. Dated April 8. 4d. The object of this invention is to simplify and cheapen the construction of dynamo and magneto-electric machines, increase their electrical capacity or working power, lessen the cost of the mechanical or driving power employed for rotating the machine, and make the electric currents more nearly continuous. It consists of improved forms of the armature enclosed by and between the pole faces of the electro-magnets of magneto and dynamo-electric machines. Secondly, improved forms of armature cores. Thirdly, a rotary automatic "circuit maker and breaker." Fourthly, combining a rotary circuit maker and breaker, with an outer or external circuit or "shunt," so arranged as to direct or draw out of the main circuit the opposing currents, and by this means neutralise their evil effect. Improvements in lamps are also included.

1476. "Telephones, &c." H. J. HADDAN. Dated April 16. 6d. (Communicated by Abner Mulholland Roseburgh, of Toronto.) Relates more particularly to the combination of a telephone and signalling apparatus in one instrument, and consists in directly or indirectly making use of a single or compound magnet in common, both for the telephone and for the signalling apparatus. Secondly, in a method of generating different qualities of electric currents so as to be able to affect either an armature or a diaphragm of a distant instrument or instruments. Thirdly, in a method of constructing a magneto-electric signalling apparatus so that it may be inserted in a branch line, or a derived line of any galvanic circuit, without interfering with the action of the said galvanic circuit. Fourthly, in a method of constructing a telephone so as to be able to dispense with a diaphragm of iron or other similar material, capable in itself of producing, when vibrating, induced currents in an electro-magnet in proximity thereto.

1477. "Telephonic apparatus." H. J. HADDAN. (A Communication from G. Black, of Hamilton, and Albert Mulholland Roseburgh, of Toronto). Dated April 16. 6d. This relates more particularly to a method of using a condenser, or in lieu thereof, a resistance medium or its equivalent, so that a telephone and an induced current signal apparatus may be connected with the wire of a galvanic circuit without interrupting the action of the said galvanic circuit. It includes:—A method of attaching two or more branch lines to a galvanic circuit, so as to establish a telephone circuit. Secondly, a method of connecting two or more parallel telegraph wires, and using them as a single conductor for a telephone line, for the double purpose of reducing the resistance of the line, and diminishing the injurious effects of foreign induced currents, as well as to be able to use wires that are also used for ordinary telegraph purposes. Thirdly, a method of connecting two or more parallel telegraph wires, so as to establish an induced current circuit without grounding. Fourthly, a method of connecting two or more independent galvanic circuits, so as to be able to utilise the wires of the said galvanic circuits for the construction of an induced current circuit. Fifthly, a method of grounding a telephone line at pleasure. Sixthly, a method of interrupting a galvanic circuit for the purpose of signalling without breaking the induced current circuit when telephones are used on the same lines. And Seventhly, an automatic circuit closer, so arranged that when the telephones are not in use the galvanic circuit is kept automatically closed.

1668. "Portable magnetic appliances." THOMAS WELTON. Dated April 28. 4d. Has for its object the union or adaptation of portable magnets, in conjunction with medicinal substances, to the various parts and all parts of the human body, for the alleviation and cure of diseases, and consists of horse-shoe magnets, or thin plates, or bars of steel, or woven steel wire, or woven wire cloth, or steel filings imbedded in, or covered by, any suitable medicinal substance, and laid on cloth, leather, or any pliant material.

2011. "Electro-magnetic pens." JOSHUA MOSES JOSIAS. Dated May 20. 6d. Consists of an electro-magnetic puncturing pen, constructed with the puncturing-needle, the electro-magnet, and the battery, so that they form one compact portable instrument, all the parts thereof being enclosed or shielded in a suitable case capable of being conveniently carried in the pocket like an ordinary writing-pen, and also consists in a roller saturated with a suitable ink or colour, and provided with an internal loose weight to press out the ink or colour for printing through the punctured plate or paper upon the required material.

2705. "Mariner's compass." W. R. LAKE. (A communication from Stephen Longfellow, of Philadelphia). Dated July 3. 6d. Consists in certain improvements in methods of, and devices for, preventing the deviation of the compass-needle from its proper direction, caused by the effects of local attraction, and to certain improvements in weighting or ballasting the compass bowl, and thus obviating the necessity of having two compasses, the one heavy and the other light.

A LARGE ELECTRO-MAGNET.—Mr. Charles Reitz, of Indianapolis, Ind., says the *Scientific American*, sends us a description of a large electro-magnet made by him for Professor Zahm, of the University of Nôtre Dame. The length of the cores is 30 inches, diameter 4 inches. Heads, of rubber, ½ inch thick, 9 inches in diameter. The yoke is 3¾ inches thick, 6½ inches wide, and 18 inches long, with 3-inch slots to admit of moving

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the cores. The bolts which connect the cores with the yoke are 1¼ inches in diameter. The cores are wound with eight layers of No. 6 cotton-covered copper wire, the wire being wound double, and the alternate layers being provided with terminals, which are connected with a plug switch on the baseboard, so that the electric current may be sent through the coils in various ways. The magnet is provided with two sets of pole extensions for diamagnetic experiments, one set being conical, the other flat. The armature is 15 inches long, 3 inches thick, and 4 inches wide. Different effects may be produced in this magnet by connecting the coils with the battery in different ways. The changes that may be made in this way are almost without number. It is estimated that the magnet, with proper battery power, will lift three tons. The weight of the magnet and its attachments is 800 pounds.

THE DEPHOSPHORISATION OF IRON.—The adoption of the Thomas-Gilchrist process for the dephosphorisation of iron at Messrs. Bolckow, Vaughan, and Co.'s works at Eston has been followed by its introduction in Germany. Operations have there been carried out by the Hœrder Hütten Verein, at their Bessemer works, near Dortmund, in Westphalia, where the manufacture of the basic bricks is also carried out. A very low grade of pig iron has been used, containing an average of 14 per cent. of phosphorus and about an equal amount of silicon. In some charges a white pig, containing nearly 2 per cent. of phosphorus and but little over 1 per cent. of silicon, has been employed. The phosphorus in the steel produced from this pig is reported to average ·06 per cent., the silicon in all cases being *nil*. As might be expected, the steel produced is of peculiarly high quality, has in every case rolled and forged well, and has given the most satisfactory results when tested under a falling weight and in the testing machine. It may be mentioned that in no case has there been any lack of heat in the metal, notwithstanding the low percentage of silicon in the charge. That a very high percentage of phosphorus and a low percentage of silicon are no obstacles to the successful conversion of pig into Bessemer steel of the best quality under the Thomas process is demonstrated by these results.

WE have received from Mr. Edward Paterson, of Bedford Court, Covent Garden, a copy of his new catalogue of apparatus suitable for scientific lectures. It includes a list of apparatus for lectures, the cost to hire or to purchase same, also an extensive list of slides for magic lantern to illustrate lectures on Natural Philosophy and Experimental Physic, Magnetic Curves, Sound, the Telephone, Microphone, Phonograph, etc.; Lamps, Magneto and Dynamo-electric Machines, and Application of the Electric Light; Human Physiology, Astronomy, Spectrum Analysis, Light, and Underground Life, or Mines and Miners. To all who lecture on scientific subjects, or who use the lantern for teaching or amusement, the book must prove of great service and interest.

The following are the final quotations of telegraphs for 27th Nov. :—Anglo-American, Limited, 55½-56½; Ditto, Preferred, 81-82; Ditto, Deferred, 31-32; Brazilian Submarine, Limited, 7⅞-7⅞; Cuba, Limited, 8-8½; Cuba, Limited, 10 per cent. Preference, 15-16; Direct Spanish, Limited, 2-2½; Direct Spanish, 10 per cent. Preference, 11¼-11⅜; Direct United States Cable, Limited, 1877, 10¼--10½; Eastern, Limited, 8⅜-8⅝; Eastern, 6 per cent. Debentures repayable Oct., 1883, 102-105; Eastern 5 per cent. Debentures repayable Aug., 1878, 102-104; Eastern, 6 per cent. Preference, 11⅛-12⅛; Eastern Extension, Australasian and China, Limited, 8⅜-8⅝; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, ½-1½ pm; Ditto, registered, repayable 1900, 1-2 pm; German Union Telegraph and Trust, 7½-8; Globe Telegraph and Trust, Limited, 4⅞-5⅛; Globe, 6 per cent. Preference, 11-11¼; Great Northern, 8½-8¾; Indo-European, Limited, 22½-23½; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Reuter's Limited, 9½-10½; Submarine, 230-240; Submarine Scrip, 2⅛-2⅜; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference 7¼-7¾; Ditto, ditto, Second Preference, 6¾-7⅛; Western and Brazilian, Limited, 4¾-5; Ditto, 6 per cent. Debentures "A," 98-101, Ditto, ditto, ditto, "B," 96-100; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 34¾-35¼; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2¾-3; India Rubber Co., 12⅞-13¼; Ditto, 6 per cent. Debenture, 105-107.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £110,379.	Direct U.S. Co. £1,213,900.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £881,210.
	£	£	£	£	£	£	£	£	£	£	£	£	£
October, 1879...	80,490	*16,158	3,000	1,371	26,830	50,251	31,419	21,987	... ...	*a*	... ...	*14,209	4,606
October, 1878 ...	54,150	13,138	2,835	1,107	18,050	41,678	23,393	19,737	... ...	10,623	2,750	*a*	5,016
Increase	26,340	3,020	165	264	8,780	8,573	8,026	2,250	... ...	... ...	... ...	... ...	... ...
Decrease	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	410

* Five weeks. *a*, not published.

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. VII.—No. 165.

SCIENTIFIC AND UNSCIENTIFIC APPRENTICESHIP.

AN important paper has recently been read by Professor Sylvanus Thompson, before the Society of Arts, on "Apprenticeship: Scientific and Unscientific." The subject is, at the present time, one of the highest interest, and following so recently as it does upon Professor Ayrton's paper on "Technical Education," it cannot fail to be of very considerable weight. That a certain amount of training is given under the present system of apprenticeship Professor Thompson does not deny, and indeed it must be evident that he cannot do so; but the amount of information and practical knowledge which the apprentice may pick up is very far short of what should be the case, considering the lengthened period during which he is practically under rulers and governors. This, as Professor Thompson points out, is due to the utter want of system at present pursued in the training of apprentices. As is truly pointed out—

"Since apprenticeship is a process of learning something, it is clearly, like every other process of learning, subject to definite principles or general laws. Just as there is a right way and a wrong way of learning to read, or to cipher, or to write, so there is a right way and a wrong way of learning a trade or an art, a handicraft or a profession. Unfortunately," continues the Professor, "although in each case this observation may at first sight appear to be a truism, it is strange how far the majority of mankind are from believing that there is a genuine science of education, the general principles of which are equally applicable not only to the processes of learning how to read, to cipher, and to write, but also to those of learning how to build houses, to print books, to construct machinery, to compound drugs, or to mould porcelain or glass."

A system of training exists in many professions, and, as is pointed out, in none is this principle carried to such an extent as it is in the profession of medicine and surgery, a natural consequence, perhaps, of the vital importance of the subject; since our very existence is practically more dependent upon a thorough knowledge of the healing art than upon anything else. But if a system is necessary for a thorough knowledge of the profession referred to, it is a logical consequence that the converse is the case, viz., that to obtain a thorough knowledge of any trade or profession a systematic method of teaching it is highly necessary. Taking a supposititious case, Professor Thompson says:—

"Suppose we had the duty of training a youth for the medical profession, what kind of training should we give him to prepare him for his career? I presume we all know that no man can practice in this country as surgeon or physician without a diploma or licence, and that such a diploma or licence is only granted to those who have been for several years pursuing a course of studies in the theory and practice of their future profession, and have attained to a certain degree of proficiency, as attested by the certificates they produce from one or other of the various recognised medical schools.

"Suppose, however, that leaving the accepted routine of lecture-going, reading, dissecting, and hospital practice, prescribed in the schools of medicine for our young aspirant, we were to adopt the following course:—Keep the youth for five years studying metaphysic and dialectic; then, at the end of this period, send him straight to work amputating and drugging, under the directions of an overlooker, whose best qualification was that he could drive the young student through the greatest amount of paying work in the shortest possible time. Suppose, moreover, all theoretical instruction, all access to books, to be carefully eliminated, and that meantime he should be taught to laugh at and despise the notion that theoretical knowledge was of any service to him, even dissection for the sake of adding to his knowledge and experience being forbidden him as not being paying work. Suppose this to go on for seven long years, the only change in the routine being that towards the close of his time that he should no longer be required to perform such menial offices as washing floors or running errands. Suppose, I say, this course to be adopted and deliberately defended as a system of medical education, what would be thought of it?

"Yet, strange as it may seem, the outrageous course which we have allowed ourselves to suppose is a faithful analogue of that which in thousands and hundreds of thousands of cases is going on today, not in the apprenticeship to the medical profession, but in the apprenticeship to the handicraft trades. For the five years of metaphysics, read five years of purely literary study in the elementary school; and for seven years of unintelligent and uninstructed work, read seven years of unintelligent and uninstructed drudgery in a workshop, under an uneducated, unsystematic overlooker, selected for that post simply because he is a good slave-driver; and you have a not overdrawn picture of that which goes by the name of 'apprenticeship' in too many of the handicrafts of England."

This state of affairs, which is well pictured, has not always been the case, it is simply a consequence of the changed social habits of the nation; formerly the apprentice was, in the majority of cases, looked upon and treated almost as one of the family of his employer, and as such naturally took an interest in his work, now these relations no longer exist. The capitalist is essentially the employer, and an employer who deputes his manual work to an underling who practically can have no

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interest in furthering the advance and imparting knowledge to the apprentice. How is the education of apprentices to be made to harmonise with the existing state of affairs, so that he may be able once more to have a fair chance of learning his craft in an intelligent and scientific manner? Professor Thompson points out the way in which this can be done, he says in answer to the question,

"What are the principles that must underlie the attempt to reconstruct in a manner adequate to modern, social, and industrial conditions, the rational scientific apprenticeship of the future?

"Those general principles may, I think," says the Professor, "be laid down without much difficulty: what difficulty exists will be found rather in the application of those principles than in their abstract enunciation.

"*Firstly*, in learning to perform any handicraft operation, or to use skilfully any tool or appliance, it is evident that the ability to do that one thing rapidly and well can only be acquired by practice; and that the beginner must learn by doing the thing many times over, slowly and carefully at first, rapidly and well afterwards.

"*Secondly*, where, as in the case of most skilled (and in many so-called unskilled) industries, the craftsman must know how to do a great many things, or to use many different tools, it is evident that the process of acquiring the complete knowledge of the craft will be much facilitated if the learner be not kept doing over again that which he already knows how to do rapidly and well. Having gained skill in one operation by doing it often enough to acquire speed and precision, he ought at once to set about mastering the difficulties of some other operation. If he is kept for months or years doing over and over again that which he already knows how to do rapidly and well, and is employed as a cheap machine simply to put money into his master's pocket, he is losing just so much time of his apprenticeship.

"*Thirdly*, all practical operations which have thus to be learned by repetition ought to be presented to the young apprentice in a graduated order best suited to his growing powers: the easy first, the harder as he gains power and knowledge. There is in every craft an order in which the round of skilled operations are best learned, an order not to be hastily settled, but known only to those who have themselves been trained and have had to train others, and is clearly an order in the course of which the learning to do one thing shall best prepare the way for the learning to do the next. The round of manual acquirements ought to be rationally and systematically arranged.

"*Fourthly*, no apprentice should be allowed to do anything without being shown or told how to do it. It is a point of the utmost importance that the young workman should never be allowed to work unintelligently; the habit of unintelligent working once acquired is hardly ever thrown off. The prevailing idea in this country seems to be that a man ought to learn how to do a thing by simply doing it; whereas the *rational plan is to ascertain first how it should be done, and then to do it.* There is always a best way of doing a thing, known only to men of intelligent practical experience. No work should be attempted by a beginner until the method and *rationale* of it has been explained to him. He will thus be saved from trying bad and useless methods, and will be called upon to use his reasoning faculties. There can be no question that theoretical knowledge may thus be of great service in saving a workman's time. This constitutes, indeed, the main difference in many trades between the practical training of English and Continental workmen. One is supposed to learn simply by doing the thing over and over again, blindly and unintelligently; the other is supposed to learn by first learning how the thing ought to be done, and then doing it.

"*Fifthly*, instruction in the general principles of science, which underlie almost all handicraft trades, ought to be taught systematically to the apprentice by teachers who understand what they are teaching, and who also are acquainted with the practical details of the applications of those principles to the particular trade followed by the apprentice, so that they may be able to point out continually the agreements and the apparent discrepancies between abstract theory and the actual methods of practice dictated by experience.

"*Sixthly*, instruction in manual exercises ought to begin early. The dexterity of hand, the quick perception of the eye, are not to be attained after a certain age. In many skilled crafts this age is indeed very early. Musicians know how early the child must begin to practise whose fingers are to acquire a perfect training, and there are many industries requiring a skill of hand little short of that which the violin player or pianist must possess.

"*Seventhly*, throughout the period of apprenticeship, but particularly in its early stages, the manual exercises set to the apprentice should be chosen solely because they will improve his growing capacities; the idea of making him do paying work ought to be set aside. The thought should be, not what will pay now, but what will pay twenty years hence. Therefore, every other consideration should be subordinated to the desire to improve the skill of the apprentice.

"*Eightly*, to give breadth and generality to the practical knowledge of the apprentice, he should, in the early stages of his training, see something of various kinds of work; there being undoubted advantages in a carpenter, for example, and a smith knowing something of each other's work. Too early a specialisation cramps the powers alike of the hand and of the eye."

In our last number of the JOURNAL, in speaking of "Technical Education" we alluded to the well fitted educational establishments on the Continent, and Professor Thompson, in his paper, speaks with great interest of these schools, as fulfilling his idea to a great extent of what a place of the kind should be. He says:—

"I propose now to turn to some of those continental institutions in which it appears to me the principles laid down as those underlying a rational and scientific apprenticeship may be seen in operation.

"We are probably all aware of the innumerable and splendid technical schools and colleges which exist in Germany, Switzerland, France, Austria,

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Belgium, and even in Russia. I will name as types of them the *Polytechnikums* of Dresden, Stutgardt, Berlin, and Zürich, the three *Ecoles des Arts et Métiers* of Aix, Angers, and Châlons, and the *Ecole Centrale des Arts et Manufactures* of Paris. These institutions do not profess to teach any trade or industry, except engineering, which in some of them is a special feature; they are colleges for applied science to which educated persons may resort to add to their technical knowledge. Hence, while admirable for giving to foremen, masters, and the professed teachers of applied science, the higher technical training those persons need, they do nothing directly for apprenticeship. Indirectly, however, they do a great deal in their respective countries for apprenticeship in the mechanical trades, inasmuch as they provide what in England we have no recognised means of providing—trained men as heads of workshops; men who are superior to rules of thumb, and who have some notion how to train the young beginners placed under their charge."

Of one of the "apprentice schools proper" the following interesting account is given:—

"The *Ecole d'Apprentis* of Paris, situated in the Boulevard de la Villette, is a school of similar character, but surpasses the Havre school in size, in the extent of its appliances, and in the general superiority of its organisation. The results attained by this school are truly striking. No pupil is admitted before thirteen, nor without his certificate of elementary education. The course of instruction lasts three years, about half the day being given to schooling, and half to practical work in one or other of the workshops. The lads, who go out at sixteen or seventeen, are able at once to rank as skilled workmen, earning a wage usually only obtained by those who have served a much longer apprenticeship in the shops, and in some cases to earn higher wages than the average skilled workman who is of age. Happily, the promoters of this school have viewed the experiment in a truly scientific spirit, and the exact date which they have kept upon all statistical matters enable a precise estimate to be drawn of the signal success attained by the school. The school was founded in 1873. Of 74 apprentices who had gone out up to August, 1877, 69 remained faithful up to the present year in the industry taught them in the school; and their average rate of payment on leaving had been equivalent to 18s. a week, reckoning 56 hours to the week's work; their average age on leaving being seventeen years and a half. Some of these, the young smiths and metal turners, earn more than this, and receive from 20s. up to 30s., and even 32s. a week, as soon as they go out to work. Now, this school is one where there is a graded series of manual exercises, where those exercises are undertaken solely to develop the pupil's skill without reference to their commercial profitableness, where no work may be attempted until the how and why have been explained, nor until the piece of work has been made the subject of a proper working drawing. It is a school where regular systematic, technical, and scientific principles are both instilled in class and insisted upon in the workshops. The instruction is not left to uninstructed workmen, but is in the hands of competent teachers, the head of the workshop staff, for example, being himself a former pupil of one of the *Ecoles des Arts et Métiers*, and thoroughly imbued with the scientific spirit, while the teacher of physics is an accomplished assistant in the Paris Observatory. The director, M. Müller, is himself animated with the spirit of the institution, and conducts excellent classes in descriptive geometry and other subjects. M. Bocquet, the superintendent of the workshops, gives a course of technological lessons, which, beginning with descriptions of tools and bits of machinery, bolts, nuts, keys, &c., leads up a complete knowledge of machinery and of machine tools. Drawing, applied physics, applied chemistry, algebra, arithmetic, geometry, and even industrial jurisprudence form parts of the curriculum of studies. To visit this school and its workshops—and I have visited it seven times, and spent many hours within its precincts—is sufficient to dispel the notion that the rational scientific apprenticeship advocated here, and in my pamphlet on 'Apprenticeship Schools,' is an impossible or Utopian idea, incapable of existing anywhere, except on paper. The problem is solved; and it is now simply a question of cost how far this solution can be applied."

No one reading this glowing account of the means of technical education existing abroad can help seeing how far we in England are behind hand; but where are the practical results we would ask? As we have before remarked, how is it that with such great educational advantages the foreigner has not ousted the Englishman and drawn away all his trade? It is true Professor Thompson points out a few cases where our trade is at a low ebb, but the latter we should imagine would be universal, and this is not so. By all means organise a system of schools having the foregoing objects in view, but ascertain first whether the entire system is founded on the best principles, and then go to work.

In concluding his paper Professor Thompson says:—

"There is no question whatever but that the persistent neglect of technical education in England will sooner or later ruin her in the markets of the world, which will be seized by less favoured but more highly trained nations. And the work of technical education is only half begun if it stops short of regenerating the education of the apprentice.

"The skilled industries of Great Britain, with their irregular bands of workers, trained anyhow, nohow, armed with fantastic scraps of empirical knowledge, and swaddled up in rules of thumb, are doomed before the industries of nations who bring into the field ordered legions of trained workers equipped with intellectual weapons, and clothed with sound science. Against such adversaries all the stores of coal and iron in our hills and valleys will be of little avail. We have, however, one chance left; we must adapt our systems to the new social order, and organise and drill and train our workers in a systematic and scientific apprenticeship, in accordance with the dictates of right reason, and in harmony with the spirit of the age."

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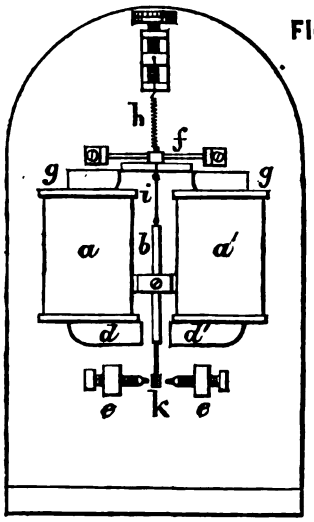
BRIGHT'S IMPROVED RELAY.

THE object of this invention is to obtain great sensitiveness and certainty of action. In the ordinary relays in which a complete signal is made by a single current, the moving part is brought back to its place of rest or zero by a spring, or by one portion of the moving part being heavier than another, or by an electro-magnet being polarised by a permanent magnet. In these methods of controlling the moving parts of the apparatus, the magnitude of the signal given, or the force with which contact is made, when a local circuit is made by such moving part, represents only the difference between the power of the electrical current employed and the force of the controlling agent. In the improvement invented by Sir Charles Bright, the moving part of the receiving apparatus by which the signal is given or the contact is made, whether it be a magnet, a soft iron armature, or a coil of insulated wire, is controlled by a second moving part, which is worked

FIG. 1.



by the same current in such a manner as to withdraw all restraint from the first or signalling part while the current is passing, and to bring it back to zero and retain it there when no current is passing. Fig. 1 shows the front elevation of a relay constructed upon this system and adapted for making contact on either side, according as a positive or negative current is sent. a, a^1, are two electro-magnets fixed vertically on an upright frame which have opposite poles when a current is passed through them; b is a permanent magnet presenting one of its edges to view; it works upon a centre at c, and is influenced by the poles d, d^1, of the electro-magnets; e, e^1, are two insulated contact screws; f is a soft iron armature acted upon by g, g^1, the upper poles of the electro-magnets; h is an adjustable spring. b is joined to f by i, which is a hair, or thread, or piece of fine wire. When no current is passing, the spring h holds back the armature f as far as the connection of f with b by i will allow, and b is thus retained at zero, the contact piece k at its lower end being midway between e, e^1. Upon the passage of a current, whether positive or negative, the armature is attracted by g, g^1, its control over b by means of i ceases for the time, and b is free to move without any retarding force to either side, according to the direction of the current.

When a current of one kind only is used, as with the ordinary Morse alphabet, a soft iron armature may be advantageously used in place of a magnet. Fig. 2 shows a plan, and fig. 3 a front elevation of an instrument so constructed, the letters in the figs. referring to the same parts; a, a^1, are two electro-magnets fixed horizontally; b is a soft iron armature carried by a lever c working on its centre d. The armature b enters between the poles of the

FIG. 2.

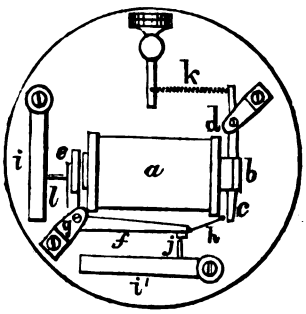
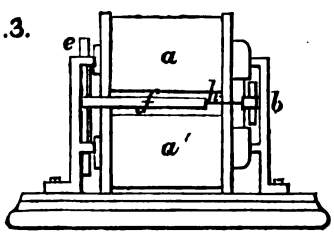


FIG. 3.



electro-magnets in the manner shown at f in fig. 1; e is an armature at the other end of the electro-magnets fixed to the lever f which works on its centre g; f is connected to c by the thread h; i, i^1, are two metallic reeds or sounders which are only shown in Fig. 2 with projecting pins j, j^1; they are insulated from each other, and by connecting g to one side of a local circuit and i^1 to the other, the signals may be read by sound and recorded at the same time; k is an adjustable spring by which, when no current is passing, b and c are drawn away from the poles of a, a^1, as far as is permitted by the connection h, the tension of which derived from the spring k, though c causes f, e, to press against j. Upon a current passing, the action of k upon h is withdrawn by the attraction of b to a, a^1, and h is moved against j by the attraction of e to a, a^1.

It is evident that the principle involved in the apparatus can also be applied to other telegraphic apparatus, and to the ordinary single needle instrument. In this case the front index needle of the instrument has simply to be attached to a prolongation of the axis of b.

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THE GLASGOW ELECTRIC FIRE ALARM SYSTEM.

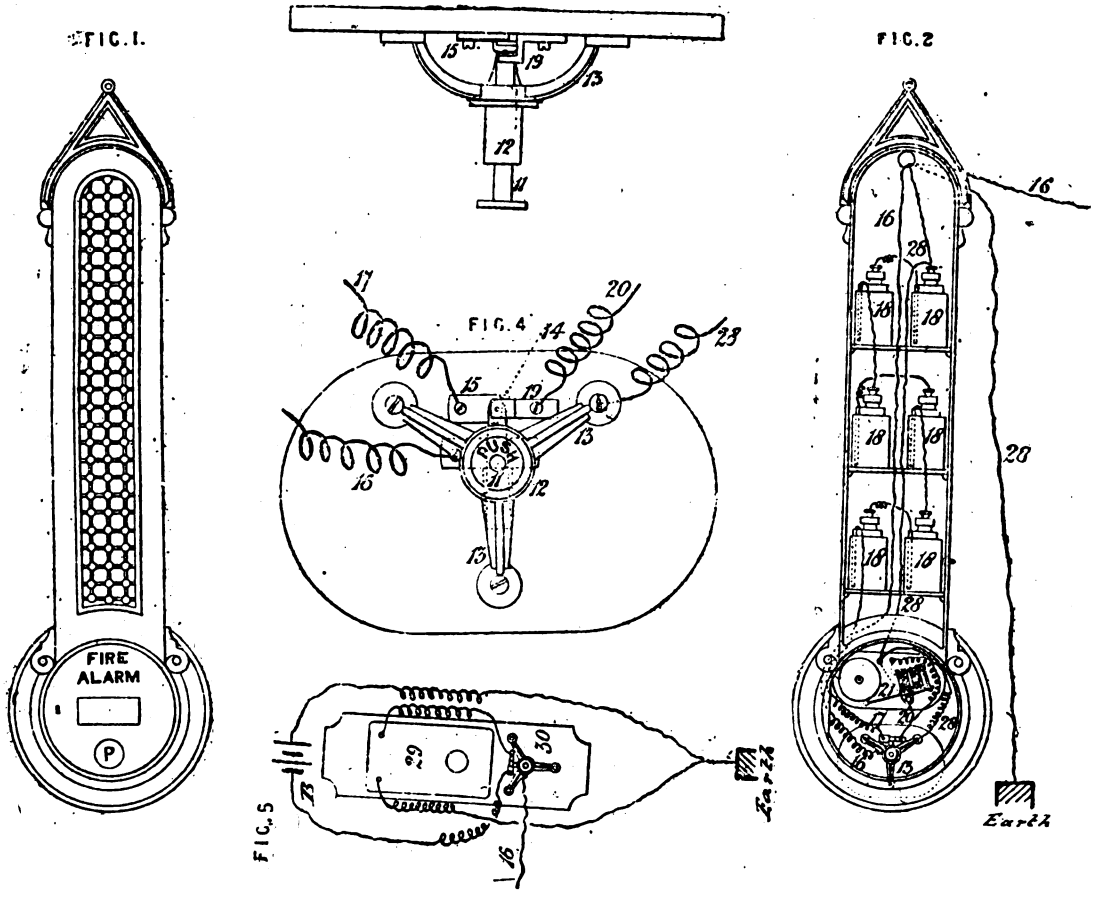
A SYSTEM of electric fire alarms has now been in use at Glasgow for some years, and has been very successful. The apparatus is very simple in construction, and little liable to get out of order. As the question of fire alarms is likely to receive more attention in this country than has hitherto been the case, a description of the Glasgow apparatus may prove interesting.

Fig. 1 shows the outward form of the signalling apparatus, which is placed at the corners of a number of the streets in the town. The arrangement

Fig. 2 shows an inside view of the wall-box. The upper part is occupied by batteries 18, placed on shelves as shown. In the lower part is fixed the push key 13 (which is shown on an enlarged scale by figs. 3 and 4) and the acknowledgment bell 21.

The push key 11 (fig. 4) is a tube having an annular head on its outer end, on which the word "push" is marked, and it is carried in a tubular bearing 12, fixed on a three-armed bracket 13. A helical spring is arranged inside the tubular bearing 12, to press the push key 11 outwards, and when the key is pushed inwards its inner end acts on a metal spring 14, and causes it to make a contact with a piece of metal 15, thereby closing the circuit

FIG. 3.



consists of a cast iron box, about 4 feet high, placed sufficiently high up on the wall of the building to which it is fixed to be out of easy reach of loiterers, but yet sufficiently low to be got at with a little exertion. To sound an alarm it is only necessary to depress the push key P, when a bell is rung at the fire station with which the apparatus is in communication, and on the receipt of the signal at that place an acknowledgment signal is returned, which sounds a bell placed in the lower part of the case.

of the wire to the district station, and sounding the bell at that station. The spring 14 is connected to the line wire 16 (figs. 2 and 4), and the metallic piece 15, into contact with which the spring 14 is pushed by the key 11, is connected by a wire 17 to the battery 18, shown in fig. 2 as occupying the upper part of the fire-alarm box. When the spring arm or switch 14 is not pressed in, it forms a contact with a metallic piece 19, which is connected by a wire 20 with the electro-magnetic bell 21 in the

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fire-alarm box, and this bell can consequently be sounded from the district station to show that the alarm signal has been noticed.

At the district station (fig. 5) there is provided for each street fire-alarm box that is in connection with the station an electric bell 29 and a push key 30, like those in the street fire-alarm boxes. The parts are arranged so that by simply pushing in the key 30 the battery B sends a current to line which causes the bell 21 at the street box to be sounded, thus acknowledging the receipt of the alarm.

Mr. R. S. Symington, of Glasgow, has recently patented an improvement in the apparatus, by which a portable A B C or other instrument can be very readily put in connection with the line, and thus a correspondence be carried on with the fire station. This addition to the apparatus is effected by means of an improved push key. This push key is made tubular to receive an improved connector or switch plug, which is connected to the portable Wheatstone, or other suitable telegraphing instrument or telephone, by a pair of insulated wires corresponding respectively to the line wire and the earth wire. The switch plug is formed with a handle of wood, and with a metal tube to be entered into the push key, and an insulated wire corresponding to the line wire passes through the tube and projects from its end, whilst the other insulated or earth wire is connected to the tube. When the switch plug is inserted in the push key its tube makes contact with the key and is thereby connected to earth, whilst the central wire makes contact with the spring 14, and through it makes connection with the line wire proceeding to the district station, and at the same time depresses the spring midway between and out of contact from the earth and battery connection. In this way a portable telegraphing instrument can be instantly connected to any of the street alarm boxes without any screwing or unscrewing of wires or other parts, and give the fireman or others the power of communicating with the fire station. At the latter a similar improved push key is fitted in connection with the wire from each street box, and a switch plug is connected to the instrument communicating with the central station. Ordinarily this switch plug is entered into a fixing giving connection with earth, but when required it is inserted into the push key connected to one of the street alarm boxes, and then communications can be transmitted directly between the fire station and the particular street alarm box.

TRIALS OF THE JABLOCHKOFF AND WERDERMANN ELECTRIC LIGHTS IN PARIS.

SOME trials of the Jablochkoff and Werdermann Electric Light systems have recently been made at the French National Opera House, Paris. The experiments took place in the Opera *foyer*, or green-room, in the presence of a large number of persons interested in the result of the trials. The object in view was the comparison of the two systems.

Ten chandeliers were taken for the experiments, four being lighted by each system and the remaining two by gas.

The first experiments were made with the Jablochkoff system, the candles being covered with yellowish coloured glass globes was to cut off as much as possible the violet rays which characterise the light when obtained by the voltaic arc. "The result," says *L'Estafette*, "was to bring out all the defects of the system, as the light continually flickered, changed colour, and produced a disagreeable noise. The Werdermann light, on the contrary, was perfectly steady and quiet in character, but from the absence of glass globes was not quite so warm in tone as its rival. This, however, was an intentional defect, as Mr. Werdermann purposely exposed the light in a naked state so that its natural warmth might be seen; of course, a globe slightly coloured only would tone down the light to the required tint."

As regards steadiness and noiselessness, the Werdermann light unquestionably carried the day. As regards economy, it may be stated that the 12 Werdermann lamps (three for each chandelier) were produced by a steam engine of 6 horse-power, constructed by Hermann-Lachapelle; the 8 Jablochkoff candles (two to each chandelier) were produced by a 12 horse-power Calla engine. The dynamo machine for the Jablochkoff system was turned at a higher velocity than that for the Werdermann system; a difference requisite in consequence of the Jablochkoff candles requiring intensity currrents, whereas the Werdermann lamps are worked by quantity currents. This latter fact, although to the advantage of the Werdermann system when the lamps are placed close to the source of power, is a disadvantage when the two elements are distant one from the other, as very thick and expensive conducting wires would be required. Experiments made with the Werdermann light have shown that 5 lights, equal to 25 to 30 gas jets, may be obtained with a 1 horse-power engine.

The outlay incurred by using the Werdermann system is considerably less than that necessitated by the adoption of the Jablochkoff light, and this is no insignificant gain. It remains now for M. Garnier, the architect of the Opera house, to make his report to Government concerning the two systems, and to indicate which, after mature reflection, has the superiority. The result will be looked for with interest.

RAPIEFF'S CURRENT REVERSER.

AN ingenious form of current reverser has been devised by M. Rapieff, which is admirably adapted for reversing in cases where the currents in question are very powerful ones, and are liable therefore to burn up the contact points of any ordinary form of reversing switch; moreover, the new reverser is so arranged that it can be worked from a distance by sending a current through it from a small local battery.

Figs. 1, 2, and 3 show a front and side elevation and a section of the reverser. The apparatus is formed of a wooden block with three hollows, q, q, q, cut in it, which are partially filled with mercury. Four metallic discs (d^1, d^2, and d^3) on one axis dip their peripheries into this mercury. The two centre discs (d^2) are fixed close to, but at the same time are elec-

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trically insulated from each other; they both dip into the same mercury chamber. The extreme left hand disc (d^3) is electrically connected to the left hand centre disc, and dips into the left hand mercury chamber. The extreme right hand disc (d^1) in like manner is electrically connected to the right hand centre disc, and dips into the right hand mercury chamber.

The left and right hand mercury chambers are electrically connected together and are connected to a terminal. The centre mercury chamber is connected to another terminal, and finally the left hand pair of discs are connected to one terminal, and the right hand pair to another terminal.

The metallic discs have each a portion of their surface coated with an insulating material, as shown in the figs. by the shaded portions, so that only about a quarter of each of their metallic surfaces are exposed. The relative positions of these latter surfaces with respect to each disc is such that in one position the bare surfaces of the extreme left hand disc and the right hand centre disc are immersed in the mercury chambers, whilst the other discs remain insulated; but if the whole set of discs be rotated through 180° on their axis, then the bare surfaces of the extreme right hand and the left hand centre discs come in contact with the mercury in their respective chambers, whilst the other discs become insulated. It is easy to see that if wires be connected to the four terminals the currents passing through them will become reversed in direction by the turning of the discs through an angle of 180°.

The turning of the discs is thus effected: at the end of the axis on which the discs are fixed are circular magnetic needles surrounded by ordinary galvanometer coils (m m'), so that when currents are caused to traverse them they turn the needles as in an ordinary galvanometer, and this with a weak current. By sending a current in one direction or the other through the coils it is evident that the needles can be turned through an angle of 180° in a corresponding direction, and by thus turning the discs will reverse the direction of the main current as required. The circular or disc shape given to the magnetic needles, M. Rapieff states, is found to answer very well in practice and to give considerable turning power.

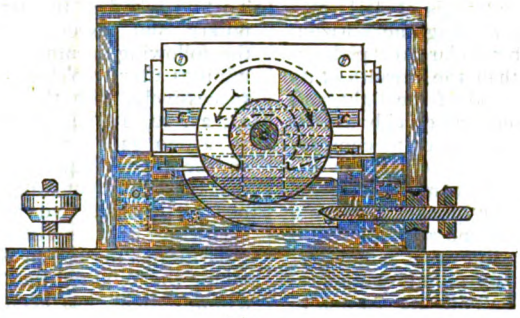

Fig. 1.

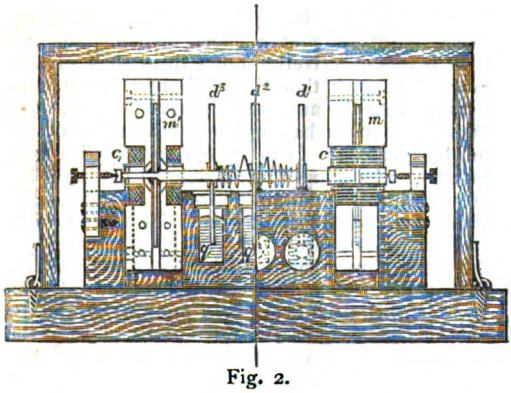

Fig. 2.

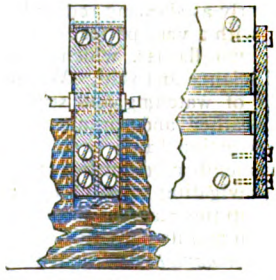

Fig. 3.

SIR WILLIAM THOMSON ON DISTINGUISHING LIGHTS FOR LIGHT-HOUSES.

The following letter has been written by Sir William Thomson to the *Times*; as its contents are of an extremely interesting character we are induced to reprint it in full:

"SIR,—A most interesting experimental cruise of ten days on board Her Majesty's ship *Northampton*, in the English Channel, from which I have recently returned, has given me many good opportunities of observing the lights on the south coast of England, and has revivified my conviction of need for a threefold reform in our lighthouse system, which I have been urging and re-urging since 1872 with hitherto but partial success:—A great quickening

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of nearly all revolving lights; the application of a group of dot-dash eclipses to every fixed light; and the abolition of colour as a distinction of light-house lights, except for showing dangers and channels and ports by red and white and green sectors. Of about 120 revolving lights on the English, Scottish, and Irish coasts, there are in all 18 in which the periods are ten seconds or less and the times of extinction seven seconds or less. In these quick revolving lights the place of the light is not practically lost in the short intervals of darkness; the eye sweeping deliberately along the horizon, with or without the aid of a binocular, to "pick up the light," passes over less than the breadth of its own field of view in the period of the light, and thus picks it up almost as surely and quickly as if it were a fixed light. And so in respect to compass bearings, whether taken roughly and quickly by inspection or more accurately by azimuth compass, the bearing of the ten-second or quicker revolving lights is taken almost as easily and accurately as if the light were continuous. But what a contrast this is to the case of the ordinary minute-period revolving light! or even the half-minute period, to which some formerly slower lights have been quickened. We had before us during our cruise in the *Northampton* excellent and interesting specimens of lights of these two periods in the Start and the Wolf. The Wolf, a half-minute light, is interesting particularly as showing red and white flashes alternately, with a very perfect equalisation of intensity of the two flashes, which is quite a triumph of optical science and skill. We had excellent opportunities of watching and studying these lights in clear weather and circumstances altogether free from navigational anxiety on board the *Northampton;* but I remember well at least two previous occasions when (navigating myself) I felt great difficulty in picking up the Start on account of its 54 seconds of extinction and its niggardly six seconds of visibility. In the *Northampton* we had ample opportunities of comparing the Eddystone (fixed light) with the Start in respect to ease of taking their compass bearings. The great contrast between them in this respects renders the Eddystone practically a much more valuable aid to navigation than the Start. The first picking up of the Eddystone contrasted very favourably with our experience in this respect of the Wolf. The Eddystone was picked up and its compass bearing taken by inspection to less than a quarter of a point, when the light was so faint on the horizon that it could scarcely be seen, or not seen at all without a little motion of the eye to refresh its sensibility. The Wolf could not be seen at all, or if seen for an instant would be lost again for many of its reappearances, until it was very much brighter than the Eddystone had been when it was effectively picked up and used. When the Wolf did come well into view, bright enough to let no flash be lost, I was agreeably surprised by the ease with which its compass bearing could be taken with all needful accuracy, and I had almost come to the conclusion that the half-minute was quick enough; but, alas! I soon found that the convenient quickness was a temporary irregularity, and that when the light seemed almost satisfactory in point of speed it was making its period more nearly a quarter of a minute than half a minute. To ascertain the truth I observed the light carefully for 15 periods, writing down the hour, minute, and second of the beginning and end of each flash. The successive periods, each stated in seconds, were 40, 35, 27, 33, 32, 32, 32, 30, 29, 26, 25, 26, 25, 19, 23, of which the least is 19, the greatest 40, and the mean 28·9. The times of darkness were 28, 24, 19, 24, 23, 23, 23, 20, 20, 19, 18, 19, 17, 13, 16, of which the least is 13, the greatest 28, and the mean 20·27. This was from 6.40 to 6.50 on the evening of the 8th of November. To find whether the irregularity was only temporary and exceptional, I observed again on the following evening, commencing this time a few minutes after 10 o'clock, and observing 24 periods successively, with the following results: 22, 22, 21, 25, 22, 28, 24, 28, 22, 30, 33, 29, 20, 26, 20, 22, 20, 21, 20, 22, 19, 27, 23, 24, of which the least is 19, the greatest 34, and the mean 23·7. It is clear that the Wolf light wants a good centrifugal governor. The distinctive value of a definite period in a revolving light is almost annulled by such irregularities as these. In fact, a serious case of mistaking the Wolf for the St. Agnes (Scilly Islands), a minute-light, has been reported. The mistake was attributed to the Wolf having been seemingly converted from a half-minute to a minute-light by its white flashes being lost, because, with equal effective intensity at a short distance, the white light is less effectively intense through a great distance of hazy air than the red light. But it is quite possible that the mistake may have been due to the Wolf mechanism having had a fit of extra slowness on the occasion. I can myself testify to a case in which it was simply impossible to distinguish revolving lights by their periods. In 1877, sailing along the Spanish coast bound for Vigo, I had for an hour or two three revolving lights all in sight at the same time: Salvora Island, "white, with red flash every two minutes;" Ons, Pontevedra Bay, "white, with flash every two minutes;" and Bayona, or Cies Islands (in the mouth of Vigo Bay), "white, with flash every minute." It was absolutely impossible to distinguish the three lights according to the description of them, quoted as above, from the Admiralty "List of Lights." The red flash of the Salvora light was not perceptibly different from the white flashes of the two others, and as to periods, the Salvora and Ons lights, each professedly of two minutes, did not differ sensibly from the Bayona light, which this time kept almost correctly to its one-minute period. But in later editions of the Admiralty "List of Lights," I see a warning of irregularity in respect to this same Bayona light, to the effect that in September, 1872, Capt. Brandreth, R.N., in Her Majesty's ship *Lord Warden*, observed it to flash every half-minute.

"Except in one unimportant case—the Dungeness Low Light, which flashes every five seconds—all the revolving lights of the English Channel are too slow, and it would be an unspeakable improvement if, with that exception, every one of them had its speed sextupled. There is no mechanical difficulty in the way of doing this. Generally the same mechanism would suffice with a mere change of adjustment of the governor; but the lightkeeper would have to wind up the weight oftener or longer. Then, instead of the two-minutes period of the Beachy Head Light with its minute and three-quarters of extinction, we should

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have a 20-seconds period, and the invisibility only 15 seconds. The Start and the St. Agnes would then give a flash every 10 seconds, and the Wolf a flash every five seconds, which is the same as Buchan Ness, the Rhynns of Islay, and the little Ross, on the Scottish coast, undoubtedly the three best revolving lights in the world. What an unspeakable improvement this would be to the lighting of the Engish Channel! The triple-flash light of the Royal Sovereign Shoals Lightship is at present very admirable, and to a patient enough observer, with time enough to spare, it is thoroughly distinctive. But the 37 seconds of darkness is a serious defect of that light, and the slowness of the three flashes, occupying the remaining 23 seconds of the period, is an altogether unnecessary derogation from the distinctiveness of character which greater speed would give them. Three short flashes in three or four seconds, with an interval of six seconds of darkness, would have an instantly recognisable rhythm (letter S of the Morse flashing alphabet); and, when once described, the light would be known to be what it is and nothing else, even before the completion of two of its 10-seconds periods.

"Revolving lights are, however, but a small minority of all the lighthouses of the world. Of the 623 lights of the British and Irish coasts, just 110 are revolving lights, and the remaining 513 are fixed, and there is a crying want of distinction for fixed lights. The distinction by colour alone ought to be prohibited for all lighthouse lights, on account of its liability to confusion with ships' and steamers' side-lights. Southsea Castle, with its red and green port and starboard side-lights, seems as if actually planned to lure on to destruction an unsuspecting enemy carefully approaching the coast with Thomas Gray's happy rule well impressed on his mind:

"'Green to green, and red to red,
Perfect safety, go ahead.'

He does so, and is wrecked on Southsea beach.

"My proposal for supplying the want is to distinguish every fixed light by a rapid group of two or three dot-dash eclipses, the shorter, or dot, of about half a second duration, and the dash three times as long as the dot, with intervals of light of about half a second between the eclipses of the group, and of five or six seconds between the groups, so that in no case should the period be more than ten or twelve seconds. This proposal has been carried into effect with perfect success in Holywood Bank Light, Belfast Lough, now the leading light for ships entering the Lough, but which until 1874 was enclosed in a red glass lantern and was only visible five miles, and was constantly liable to be mistaken for a sailing vessel's port-side light entering or leaving the harbour of Belfast, or the crowded anchorage of Whitehouse Roads. In 1874 the red glass was removed, and the light was marked by dot, dot, dash (— — ——, or letter U), repeated every ten or twelve seconds, and has been so ever since. It is now recognised with absolute certainty practically as soon as seen in ordinary weather from the mouth of the Lough, ten miles off, and has proved most serviceable as leading light for ships bound for Belfast or entering the Lough.

"It is much to be desired that the dot-dash system should be seriously considered by the lighthouse authorities of our islands. Hitherto, when attention has been called to it, it has been dismissed with a pleasantry, 'Winking lights won't do,' or else something utterly different has been gravely considered and justly condemned. It is satisfactory now to know that the Deputy Master of the Trinity Board, Sir Richard Collinson, K.C.B., has, after its character was correctly put before him by the recent Select Committee of the House of Commons on Electric Lighting, given it his approval in the concluding answers of his evidence.

"Is it too much to hope that when the new Eddystone Lighthouse is finished the light shall not be, as hitherto, an undistinguished fixed light, but a fixed light distinguished by a group of dot-dash eclipses — such as dot, dash, dot (— ——— — letter R)—which is particularly easily distinguished by its rhythmical character; and that the Needles Light, which shows red over a great area of sea south of it, and when undistinguished, as at present, is liable to be inconveniently and even dangerously mistaken for a ship's port-side light, shall have a distinctive dash, dot (——— — or letter N) given to it, which, whether in its red or on its white sectors, will instantly show it to be itself and no other light at sea or on shore? The five years' practical demonstration of the dot-dash system in Belfast Lough ought surely to weigh with the authorities. The introduction of a well-proved remedy for an admitted defect of our lighthouse system should not need that advocacy which moved the unjust judge, and the seafaring world should not suffer the delay in gaining a great benefit which the strict following of that judge's precedent would entail.

"I remain, your obedient servant,
"WILLIAM THOMSON.
"The University, Glasgow."

HOWELL'S BATTERIES.*

By C. F. HOCKIN.

HAVING lately tested several of these elements, I think the results may be interesting to some of your readers, particularly as the cell in question is, I believe, a very good one, and has a higher electromotive force than any cell with which I am acquainted.

The plates are zinc and carbon.

A cylindrical glazed porcelain vessel, about 6½ inches high and 5½ inches in diameter, contains a smaller cylinder 6¼ inches high and 2½ inches in diameter, of the same material, which is open at both ends and has four longitudinal slots in its walls.

The smaller cylinder stands with its axis vertical in the larger vessel.

In the space between the inner wall of the larger cylinder and the small cylinder (called the separator) is placed first a rod of carbon, on to which is fitted a terminal.

Around this block is a mass of broken carbon and peroxide of manganese, filling the clear space described to within about 1½ inches of the top of the cylinder. On the top of the mass is placed a layer of white manganese or native sulphate of

* An illustrated description of this battery was given in our last number.—ED. TEL. JOUR.

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manganese. The whole is kept in place by pouring hot pitch over it to the level of the top of the vessel.

Within the separator stands a cylindrical porous pot 6½ inches high and 1⅞ inches in diameter, containing the electro-positive electrode, viz., amalgamated zinc with some free mercury.

The solution in which the zinc is placed is made by dissolving 25 grammes crystals of sulphate of ammonia in one litre of water, or say, a 2½ per cent. solution.

The electro-negative element is in dilute sulphuric acid, one part acid to four parts water.

Several cells were tried.

First.—Five cells, Nos. 1 to 5, made and set up as described.

Second.—Two cells, Nos. 6 and 7, similar to the first, but in which the sulphate of manganese was omitted.

Third.—Five cells, Nos. 8 to 12, similar to Nos. 1 to 5, but in which an impure sample of manganese had been used. The results from these cells are given only to show the importance of purity in the salts used with the electro-negative element of any cell.*

Lastly.—Four ordinary Leclanché cells (Silvertown pattern, No. 1) were filled with the following solutions :—

No. 13. Dilute sulphuric acid, 250 grammes water and 12½ grammes acid.

No. 14. Same as above, with 6¼ grammes of sulphate of ammonia.

No. 15. 250 grammes water with 6½ grammes of sulphate of ammonia dissolved in it.

No. 16. 250 grammes water with 6½ grammes of chloride of ammonium dissolved in it (the normal Leclanché battery).

The weights given are of the crystalline salts.

When first set up, and before any current had passed through them, the electro-motive force of the cells was as follows, in volts :—

No. 1...2·146	No. 6...2·119	No. 8...2·112	No. 13...1·917
,, 2...2·151	,, 7...2·080	,, 9...1·912	,, 14...1·917
,, 3...2·168		,, 10...2·135	,, 15...1·544
,, 4...2·155		,, 11...2·033	,, 16...1·547
,, 5...2·130		,, 12...1·864	

From these values it appears that a Howell's cell has an electro-motive force exceeding that of even a Groves' cell (1·94 volts, Electrical Formulæ, Clark and Sabine, p. 97) by nearly 10 per cent., and exceeding that of an ordinary Leclanché cell filled with dilute sulphuric acid by 12 per cent., showing that, as might be expected, the electro-motive force is increased by the use of two liquids, one for the electro-positive plate, the other for the electro-negative.

The variation in the electro-motive force found between different cells of the same pattern was almost wholly due to the electro-negative plate, for the result was the same whether the same plate of zinc was used for all the cells, or each cell had its own plate.

The cells Nos. 8 to 12 do not show any distinct variation in electro-motive force due to the strength of the acid solution used, the irregularity in the values is due to the impurity of the manganese.

* In these cells the strength of the acid solution was as follows: No. 8, 5 per cent. acid; No. 9, 10 per cent. ditto; No. 10, 15 per cent. ditto; No. 11, 20 per cent. ditto; No. 12, 25 per cent. ditto.

Nos. 15 and 16 show that the presence of free acid, and not the nature of the salt of ammonia used, determines the high electro-motive force of the cell.

The resistance of the cells 1 to 12 averaged, when first set up, 5·7 ohms each.

To determine the work that could be obtained from the cells, Nos. 1 to 7 were allowed to run through an external resistance of 1,000 ohms, corresponding to a total resistance of 147 ohms per cell, for 16 days, from October 23rd to November 8th, without the circuit being at any time broken, and the effective electro-motive force was observed from time to time.

By the effective electro-motive force is meant the electro-motive force between the ends of the external resistance, measured while the current was flowing, or, the electro-motive force available for maintaining the current in the circuit. The results are in volts.

Date.	Total E.M.F. of Series.	Average per Cell.	Date.	Total E.M.F. of Series.	Average per Cell.
Oct. 23	14·39	2·06	Nov. 1	13·49	1·93
,, 24	13·90	1·99	,, 2	...	...
,, 25	...	...	,, 3	13·39	1·91
,, 26	...	...	,, 4	13·37	1·91
,, 27	13·63	1·95	,, 5	13·29	1·90
,, 28	...	...	,, 6	13·29	1·90
,, 29	...	...	,, 7	13·17	1·88
,, 30	13·53	1·93	,, 8	13·07	1·87
,, 31	13·58	1·94			

Showing an average loss in electro-motive force of only 0·6 per cent. per day during 16 days, and an average available electro-motive force of 1·96 volts per cell, the battery working through a total resistance of 147 ohms per cell, or about 13 miles of No. 6 iron wire.

The electro-motive force of each separate cell is given for certain dates.

No. of Cell.	Date and E. M. F. of Cell.					Percentage loss in E.M.F.
	Oct. 23.	Oct. 24.	Oct. 30.	Nov. 4.	Nov. 8.	
1	2·065	2·061	2·027	2·056	2·068	— 0·1
2	2·069	2·074	2·086	2·069	2·067	+ 0·1
3	2·085	2·079	2·041	2·004	2·022	+ 3·1
4	2·073	2·042	1·965	1·843	1·727	+ 16·7
5	2·048	1·923	1·673	1·466	1·391	+ 32·1
6	2·038	1·931	1·981	1·933	1·842	+ 9·6
7	2·009	1·785	1·751	2·030	1·943	+ 3·0

From these values it appears that the electro-motive force of the cells at starting was fairly uniform, the cells with white manganese having rather a higher electro-motive force than those without it.

After working through 147 ohms per cell for 16 days the results were not so uniform. Cells 1 to 3 had lost very little in electro-motive force and had contributed a nearly uniform quota to the whole current traversing the circuit throughout the time.

Cells 4 and 5 had diminished considerably in power.

Nos. 6 and 7, which were set up without the white manganese, had lost on the average about 6 per cent. in electro-motive force at the end of the time, but had varied considerably during the time.

The cause of irregularities in cells of the same pattern was, probably, impurity in the manganese.

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Cells 8 to 12, filled with impure manganese, were treated as follows :—

First, they were short-circuited for 24 hours, through an external resistance of 30 ohms, or a total resistance of about 12 ohms per cell; after 24 hours the electro-motive force fell to 3·06 volts, or an average of only 0·6 volts per cell.

After the circuit had been broken the electro-motive force rapidly increased; in ten minutes the values were as below :—

	Volts.		And after 24 hours. Volts.
No. 8 ...	1·638	No. 8 ...	1·870
,, 9 ...	1·693	,, 9 ...	2·040
,, 10 ...	1·019	,, 10 ...	1·690
,, 11 ...	1·597	,, 11 ...	1·877
,, 12 ...	1·408	,, 12 ...	1·977
Total	7·355	Total	9·454

A little more acid was then added to each cell, to fill them to the proper height, and the cells were allowed to run through an external resistance of 500 ohms, or a total resistance of 106 ohms per cell for 17 days. The electro-motive force varied as given below:—

	Volts.		Volts.
October 22nd ...	9·45	November 1st ...	5·79
,, 23rd ...	7·68	,, 3rd ...	4·87
,, 24th ...	7·62	,, 4th ...	4·76
,, 27th ...	7·23	,, 5th ...	4·61
,, 30th ...	6·72	,, 6th ...	4·42
,, 31st ...	6·36	,, 7th ...	4·23
		,, 8th ...	4·14

In 17 days, therefore, the cells had fallen to an average electro-motive force of only 0·83 volts, or about that of a Minotto's cell, showing the great effect of the impurity in the electro-negative plate.

Lastly, the four Leclanché cells, Nos. 13 to 16, were allowed to run through an external resistance of 100 ohms, or a total resistance of 38 ohms per cell for 24 hours; after this time the results were as follows :—

No. of Cell.	Original E.M.F. Volts.	E.M.F. after 24 hours work. Volts.
13 ...	1·917	1·409
14 ...	1·917	1·338
15 ...	1·544	0·059
16 ...	1·547	0·444

The cells without acid had, therefore, lost their electro-motive force, while those with acid had fallen to about 0·717 of their original value.

I think the values that have been given show that for many kinds of ordinary telegraphic work Howell's batteries are superior to any other in common use.

Whether they will answer for testing purposes, that is to say, whether they will maintain when at rest or when working, through a very high resistance, an absolutely uniform electro-motive force not subject to sudden instantaneous changes, I cannot say, as the only way to prove this is to observe the current from many cells entering a condenser of high capacity and very great resistance. It is perhaps unlikely that an acid battery will fulfil these conditions.

The use of a rather strong solution of sulphuric acid in these batteries will be disadvantageous under some circumstances, and in such cases the ordinary Leclanché will be preferred.

The maximum electro-motive force to be obtained by the formation of sulphate of zinc from sulphuric acid and zinc is theoretically about 2·35 volts, and to obtain an electro-motive force so near this as 2 volts under such conditions as are commonly met with in telegraphic work is a very good result.

The cell of course is not suited for working through a low resistance, and cannot take the place of a Groves' cell, a Bunsen's cell, or a very large Daniell's cell such as is used for electrolysis.

The numerical values given in this paper are based on the value of a certain Clark's cell. This cell was compared with a Daniell's cell set up with pure materials—a cell similar to a Clark's element, but in which a certain known solution of sulphate of zinc not saturated was used—and with other cells, to prove that it had not altered.

EDWARDS' SOUNDER.

A NEW form of sounder has recently been devised and patented by Mr. J. R. Edwards, Superintending Engineer of Postal Telegraphs, Liverpool.

The object of this invention is to enable "sounders" to be actuated directly by the line

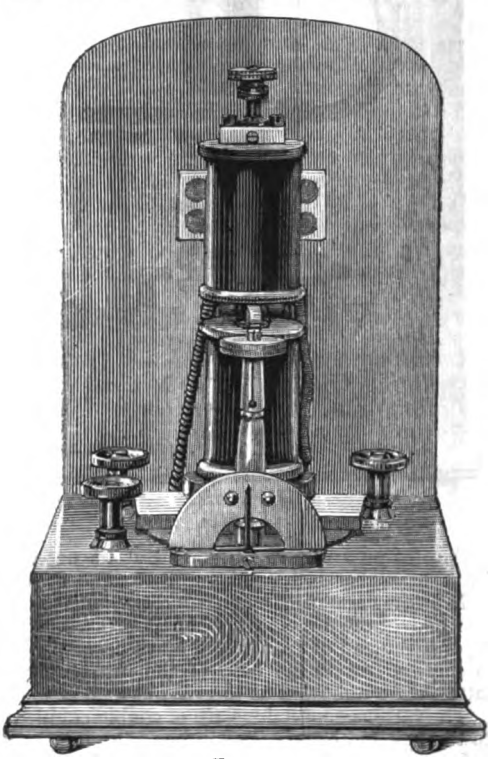

FIG. 1.

current, whether double or single, thereby rendering unnecessary the intervention of a relay and local battery power, as in the case of the ordinary "Morse" sounder, and thus simplifying and economising the means of telegraphic communication.

The instrument is shown in front and side elevation by figs. 1 and 2. It consists of a stand carrying a

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D shaped permanent magnet, one pole being made longer than the other and placed uppermost. Below this long pole is fixed a single bobbin electro-magnet having a soft iron core passing through the long pole of the permanent magnet, and magnetised by it, and made in two parts, the lower part being fixed in the bobbin and the upper part capable of being adjusted at any required distance from the other by a screw, shown at the top of the bobbin, carried on a bracket on the long pole of the magnet.

Below the shorter pole of the permanent magnet and also directly below the top electro-magnet is placed another single bobbin electro-magnet, with an iron core capable of being adjusted in regard to its height above the coil by an adjusting screw below. It will thus be seen that the iron cores of the electro-magnets face each other, with a space between them capable of being adjusted at will.

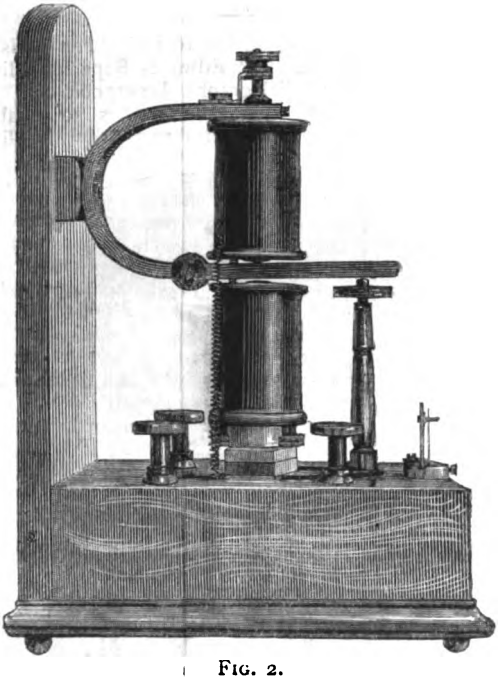


FIG. 2.

A soft iron armature prolonged at its outer end by a brass bar is hinged or pivotted to the short pole of the permanent magnet and magnetised by it; the end of the brass bar, when depressed, strikes against the end of an upright brass column, which is screwed on to the base of the instrument, the latter being hollow so as to give out a good sound.

The various connections are of course coupled up to the key and battery, as will be well understood.

In working the instrument a current passing through the coils of the electro-magnets reverses the polarity of the core of the upper electro-magnet, releasing the armature, which besides falling by its own gravity is attracted by the opposite pole of the lower electro-magnet, thus striking the top of the brass column and producing a sound.

The lower electro-magnet pole is not affected by the permanent magnet, as it is magnetised by the line current only when passing.

No reacting spring to raise the vibrating armature is needed, as the permanent magnet magnetising the pole or core of the upper electro-magnet raises the armature directly the line current is off, and this degree of magnetism is regulated as described by having the upper core in two parts adjustable to each other.

If the apparatus is worked on the "double" current system then it can be much more delicately adjusted, as the reversal can be caused to raise the armature to its normal position.

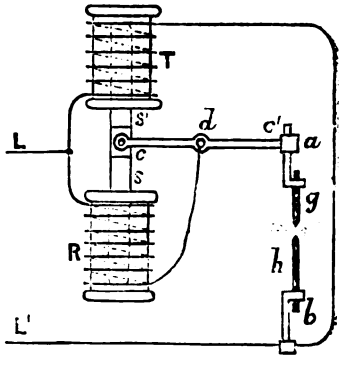
The instrument when adjusted will give a good readable sound when traversed by a current of about 10 milliwebers (1 Daniell cell through 100 ohms resistance).

A small galvanometer is placed in the front of the instrument to indicate whether a current is passing or not, should the instrument fail to work.

SIEMENS' DIFFERENTIAL ELECTRIC LAMP.

THE general principle of this lamp is shown by fig. 1 : *g* and *h* indicate the carbons held respectively in the sockets *a* and *b*, and provided with means of feeding as they are consumed. The one

FIG. 1.



socket *a* is attached to one arm c^1 of a lever pivotted at *d*, and having its opposite arm *c* connected to a piece of non-magnetic material uniting a pair of iron cores *s*, s^1. The core *s* is free to play up and down within a solenoid R, the coil of which is of large wire offering small resistance, and forms part of the lamp circuit. The core s^1 is free to play up and down within a solenoid T having a coil of smaller wire offering greater resistance than the coil of R. The coil of T is in a circuit external to the lamp, that is to say, joining the conductors L, L^1, excluding the carbons. When the solenoid R, being excited, draws in its core *s*, the points of the carbons are separated; when on the other hand the solenoid T draws in its core s^1 the carbons are caused to approach each other. As the relative force of the two solenoids depends upon the strengths of the currents of electricity passing respectively through their coils, and as this depends upon the relative resistance of their respective circuits, the one circuit

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consisting of the coil T and its connections to the main circuit of L, L^1, and the other consisting of the coil R, the two carbons, and the arc between them; that portion of the latter which consists of the arc being dependent on the distance of the carbons apart, this distance will become adjusted automatically by the action of the two solenoids, so as practically to maintain constant action of the lamp. If, for example, the carbons should be too near together a larger proportion of the electric current passing through the coil R than through the coil T will cause superior attraction of the core *s*, separating

FIG. 2.

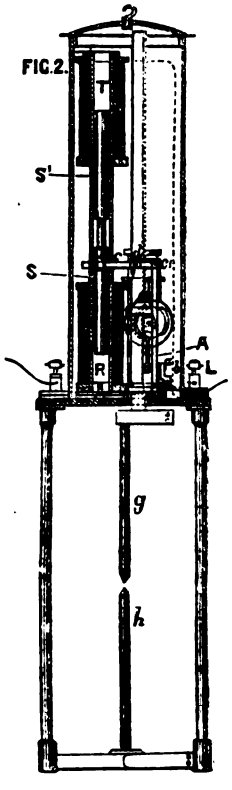
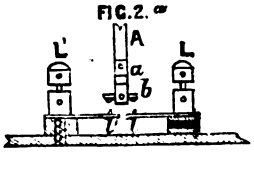


FIG. 2.ª



the carbons, and thereby increasing the resistance of the arc between them, and so lessening the quantity of electric current that passes through them. If, on the other hand, the carbons should be too far apart, then the coil R being less excited than the coil T, will exert less attractive force on its core *s*, permitting the other core s^1 to be drawn into its coil, and thus causing an approach of the carbons which will lessen the resistance of the arc between them, and so permit the passage of a larger proportion of the current through them; thus the regulation of the lamp being dependent only on the resistance of its voltaic arc, and independent of the strength of current, the action of any one lamp in a circuit will not affect that of other lamps in the same circuit, and consequently a number of such lamps can, by means of this invention, be effectually worked in one and the same circuit. Fig. 2 is a vertical section of a lamp with a pair of regulating solenoids operating as described with reference to fig. 1 in combination with one of the arrangements for feeding the upper carbon described in the Specification before referred to. In this construction R is the one solenoid having its coil of low resistance in the lamp circuit surrounding the core *s*, which is connected to the lever arm *c*. The other solenoid T having its coil of higher resistance in a circuit external to the lamp surrounds the core s^1, which is connected by a piece of non-magnetic material to the core *s*. The lever *c* is pivotted at *d* on the fixed framing of the lamp, and carries on its arm c^1 the slide and rack for the upper carbon, and the disengaging gear described in the Specification before referred to, which permits the carbon slide to descend a little to allow for waste when the automatic adjustment effected by the action of the solenoids brings the disengaging gear down to a fixed stop. To provide for continuation of the circuit in cases where a considerable separation of the carbons *g*, *h*, occurs, as when a piece of the carbon breaks off, the following arrangement is adopted:—To the frame A (which is moved up and down by the action of the solenoids R and T) is attached an insulated bracket *a*, of which a front view is shown at fig. 2ª. On this bracket is pivotted a lever *b* immediately over two spring contacts *l*, l^1, connected respectively to the conductors of the external circuit. When the frame A descends to its full extent the lever *b*, resting on the contacts *l*, l^1, completes the external circuit, so that other lamps in that circuit may continue in action, even if the one lamp becomes extinguished. When, by the approach of the carbons, this lamp again comes into action, the lever *b* is raised off the contacts *l*, l^1, by the ascent of the frame A.

THE TRANSMISSION OF MOTIVE POWER BY ELECTRICITY.

FOR some months back Messrs. John Poynter and Son have, at the Shaws Water Chemical Works, been practically and successfully testing the practicability of the transmission of motive power by electricity. The machines used are the well-known Siemens' Dynamo Electric Machines, the same with which electric lamps are worked, and the liberal supply of water from a waterfall behind the works put into the hands of the firm a cheap and handy driving power. One of these Siemens' machines is placed in a part of the works quite near this waterfall, and beside a turbine wheel, while another machine of the same kind is placed in the engineers' shop, about 150 yards off. These two machines are connected with electric wires. Briefly stated, the following is the mode of working. The water is brought from the fall, and drives the turbine wheel, while the first-mentioned electric machine is in turn driven from the shafting of the turbine by the ordinary means of belting. The electric power

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generated in the Siemens' machine is then transmitted by means of the wires through the various departments of the works to the machine in the engineers' shop. To that machine a belt is attached to drive the shafting, and in that way motive power is gained in the engineers' shop, the cooperage, and other parts of the works. For instance, the shafting driven by this electrical current from the wires attached to the Siemens' machine drives a circular saw in the cooperage, and in the engineers' shop a turning lathe and a vertical boring machine, which latter machine we saw penetrating an iron plate one inch thick with a ¾ inch bit. In a word, by the Siemens' machine placed at the turbine wheel the water-power is converted into electricity, and by the other machine in the engineers' shop the electricity is converted into valuable motive power. It must be kept in mind that the Messrs. Poynter have abundance of steam and water-power at command, and have, as stated above, tried the electric power as an experiment. These two machines can furnish from two to three horse-power, and while, of course, that is not sufficient for many practical purposes, the importance of this successful experiment by the Messrs. Poynter lies in the untold probabilities of motive power which further development of the idea may give. The experiment witnessed by us the other day at the Shaws Water Chemical Works is, so far as we know, the first of the kind in Scotland, and it only remains to be added that the press representatives on visiting the works were shown every courtesy and attention by Mr. Poynter and his assistants, Messrs. Macdonald and Cunningham.—*Greenock Herald.*

NEW RESEARCHES ON THE THEORY OF THE MICROPHONE.

By DR. JULIAN OCHOROWICZ.

II.

THE fourth class of microphones embraces those in which the current itself is produced and varied solely by the movements of the microphonic electrodes ;* these are *microphonic batteries.* Every battery may, under certain conditions, act as a microphone ; it is only necessary that one of the poles be movable. Two pieces of iron wire plunged into plain water, and brought near each other, give indications of microphonic action. Suppose then one of the poles of a battery attached to a vibrating membrane in the form of a small cone, as shown in fig. 1, the apex of which dips into the liquid, while the other pole is permanently immersed therein. The current only exists when the movable pole touches the liquid ; singing into the tube sets the membrane in vibration, and the pole, which is then one of the microphonic electrodes, dips into the liquid, and sets up chemical action as many times per second as there are vibrations in the note sounded. If the pole constantly touches the liquid the current is never broken, but varies in intensity according to four collateral causes :

1. Varying number of points exposed to electrolytic action.
2. Varying number of points making electrical contact.
3. Varying number of points of resistance of liquid stratum.
4. Varying approximation of the poles.

But it is evident that these are but four expressions of the same thing, namely, the motion of one of the *microphonic electrodes.*

It only remains for us to examine the last class of microphones. In all those hitherto known the direction of the current remains the same ; but it is possible to cause it to vary, and thus to introduce one other difference in its phases of action. Figs 2 and 3 represent the two extreme positions, exaggerated so as the better to exemplify the change ; we see the direction of the current, which is brought from the battery by two very fine wires so as not to impede the simultaneous vibrations of the two vibrators (united, but not in electric contact). In reality the two vibrating balls are never completely isolated from either of the carbons, but there is always a preponderance towards one side or the other. This microphone gives excellent results, but its construction is rather difficult. I make it more sensitive to spoken words by adjusting the two vibrators on a membrane in a somewhat more complicated manner.

In this last class then it is the points of contact themselves which change, and not merely their number.

To sum up, we may note among all the possible forms of microphones :

1. A mechanical motion of the parts.
2. *A change in the points of conductibility.*
3. A change of resistance.

And these three essential phenomena result from each other.

I say "points of conductibility," and not of "contact." "Contact," because the first expression embraces at once the points of contact and the route traversed by the current in one or the other direction. We thus arrive at a general formula. Let us now attack the special questions, above all, that of the pretended *amplification of sounds* by the microphone.

It is easy to see that this does not take place. *All sounds, considered by themselves, are always weakened by the microphone.*

But the microphone is not merely an apparatus which transmits sound electrically ; it is more especially one which *transforms mechanical vibrations into sound ;* and these may be amplified in this transformation.

Example : the ticking of a watch placed on the same plank as a microphone can be distinctly heard, although at a distance of six or seven metres. If the watch is placed on the base of the microphone itself, the sound can be heard all over a room, because it acts, not as a *noise,* but as a *mechanical vibration.* But this same watch becomes incapable of affecting the microphone when held in the air at a distance of a few millimetres, because then it acts only by its *noise.* On the other hand, a faint breath of air, though making scarcely any noise, gives the effect of wind.

The weakening of articulate sounds is greater as the sounds are more intense, so that the faintest

* I call *microphonic electrodes* the two opposed portions of the microphone which are united directly or indirectly.

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sounds experience the least weakening. Simple musical sounds, accompanied by a mechanical vibration relatively great (for example, the current of air emitted from the mouth in singing or whistling), may be somewhat amplified by the microphone, which "makes and breaks," but this amplification only takes place when the sounds are feeble.

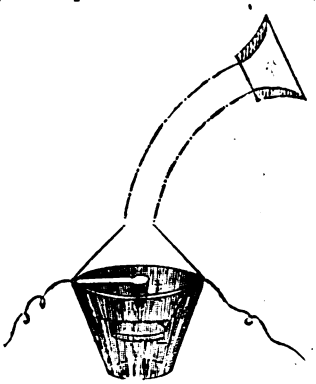

FIG. 1.

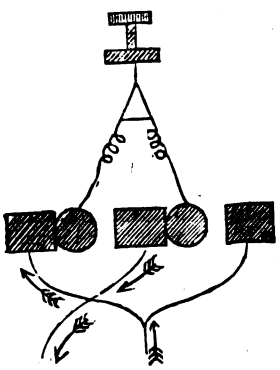

FIG. 2.

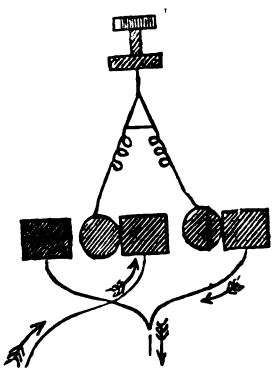

FIG. 3.

Mechanical vibrations, although unaccompanied by sound, are always transformed into sound, and this increases in intensity in proportion as the amplitude tends to interrupt the current. This interruption accomplished the augmentation at once ceases to show itself. A blast of air will act no more strongly than a breath, inasmuch as the latter is strong enough to produce a momentary but complete rupture of the current. There are two limits between which are comprised all the laws of microphonic phenomena: the inferior limit, where there is a minimum of mechanical vibration and in which a variation of contact is only just realised, and the superior limit, in which the vibration breaks the current, independently of the energy of such vibration. Beyond these there is neither amplification nor even articulation; but between them the intensity of sounds is directly proportional to the energy of the mechanical vibrations which accompany the sonorous waves. And as the vibrations of one or more parts of the microphone determine an augmentation or diminution of the number of points of good or bad conductibility we may conclude that—

The intensity of the sounds is directly proportional to the magnitude of the differential changes in the resistance of the microphone.

For the transmission of articulate sounds it is necessary that *the number of points of contact, the variations of this number during the action of the apparatus, and the variations of resistance resulting therefrom should be very great.* This is obtained in the second class of microphones by uniting small surfaces presenting only one point of contact, or by employing bodies of low conductivity. The interruption of the current is then only partial and undulatory, to use Bell's expression; and the greater the margin in this interruption or partial reconstitution the more perfect is the microphone.

THE MAGNETISM OF A WIRE TRAVERSED BY AN ELECTRIC CURRENT.

DR. BARKER has read before the National Academy, America, a paper detailing the results of certain variations of Arago's experiment to prove that a wire through which an electric current is passed becomes for the time a magnet. This view was overthrown by the tests applied by Professor Franklin Bache, some fifteen years ago.

Professor Bache placed a piece of cardboard against the wire in such a way as to cut the "magnetic field" containing the filings into halves. Immediately all the filings dropped. The inference was that the wire was not a magnet. The filings, it was believed, had been held in position before the interference of the cardboard in one of two ways: either by their magnetic adhesion to each other, or by the direct support of the currents circulating in the magnetic field. Dr. Barker has made some experiments to disprove these inferences. He employed a powerful magneto-electric machine of the Wallace pattern at Ansonia, Conn. The energy it developed was so enormous that at a distance of 7 feet an iron bar 5 feet long held opposite it would be instantly so charged with electricity as to hold up an ordinary nail. This current of electricity would heat to cherry-redness in a minute a ¼-inch gas-pipe 3 feet long. Dr. Barker performed the "experiment of Arago" with this machine, using a copper wire. Copper, being diamagnetic, seemed not so likely to become a magnet as iron. A 5-inch iron spike was held below and close to this wire during the passage of the current. The spike was attracted, but not sufficiently to lift it clear.

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When the spike was touched to the wire, it immediately stuck fast at right angles to the wire. But when the spike was removed from the wire only the thousandth part of an inch, it fell to the floor. This showed that the great energy of the magnetism was in the wire, and not in the surrounding field. Then Dr. Barker had a glass plate prepared with a hole through its centre; the wire was passed through the hole, and iron filings sprinkled on the surface of the plate. When the current was passed through the wire, the filings arranged themselves in concentric circles around it. Further experiment showed, by reversing the wire current, that in this magnetic field the currents were travelling in circles around the wire. Finally, when the iron spike was held by the head parallel to the copper wire and near it, the spike deflected itself out of the perpendicular in the direction in which these currents were passing around the wire. Dr. Barker considers that his experiments yield conclusive proof that the old view was correct—that a wire through which a current is passing does become for a time a magnet.—*Scientific American.*

Correspondence.

JOINT FOR UNDERGROUND WIRES.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—As the usual way of joining gutta-percha covered wire requires great care and attention, I have devised the following method, which I find to be both quick and effective.

The two ends of the wires to be joined are bared as usual, then a piece of specially prepared india-rubber tube three inches long is drawn over one wire beyond where the joint is to be made, the two wires are then joined in the usual way, and the bit of tube is drawn over the joint and bound at each end with rather fine tar cord, the joint is then complete.

FREDERICK J. SMITH.

Taunton, Nov. 28, 1879.

Notes.

ELECTRIC CLOCKS.—Underground wires for synchronising a number of clocks by electricity are being laid down by the Municipal authorities in Paris; the synchronising system to be adopted is, we believe, that of Messrs. Lund and Blockley of Pall Mall, London.

THE TELEPHONE IN AMERICA.—On the 1st of September, 1877, the first telephone exchange was established in Cincinnati; there are now 800 subscribers on the company's books; 800 instruments are in use, and 3,000 miles of wire on 75 miles of poles are required for the working of the system. At the Exchange office, where the various subscribers have their offices "switched" through to one another, no less than 6,000 "switchings" take place every day.

THE BELL TELEPHONE.—Professor Bell has obtained a verdict in his favour from the United States Superior Court. By this verdict his patent rights in the United States will be protected, and no telephone will be permitted to be used unless it bears the name of A. Graham Bell. The shares of the National Bell Telephone Company, which has bought up all the conflicting rights, and acquired all the telephonic inventions of Elisha Gray, Edison, and Phelps, are quoted at 700 per cent.

A NEW LIGHTNING ROD.—A company in Cincinnati has patented a new system of protection from lightning. Unlike the ordinary lightning rod, which is designed to convey the electric discharge to earth, the new system aims at warding off the lightning. For this purpose the rod is pointed at both ends, and runs along the ridge of the building it is intended to protect, and parallel to the ground. The two ends are turned upwards. This rod is supported on large glass insulators, and has no electrical connection with the ground. The theory of this wonderful and ingenious arrangement is, that the lightning will first be attracted by the points, and then dispersed into the air, without harming the building.

THE ELECTRIC LIGHT ON BOARD SHIP.—The Inman s.s. *City of Berlin*, which left for New York on the 5th, has been fitted with Siemens' Electric Light apparatus. By means of the light, the saloon, the passenger, and the emigrants' decks are illuminated. Should the trial prove successful it is intended to extend the system to other vessels.

LORD RAYLEIGH has been elected to succeed the late Professor Clerk-Maxwell in the Chair of Experimental Physics in Cambridge University. There was no other candidate. The new Professor, then the Hon. J. W. Strutt, graduated at Trinity College as Senior Wrangler and first Smith's Prizeman in 1864. He was an additional examiner for the Mathematical Tripos in 1876.

IT is notified that Sir Edward Watkin has taken the Chairmanship of the Western and Brazilian Telegraph Company, in succession to the late Mr. H. Rawson.

IT is stated that a direct conversation has been carried on by telephone in America through a distance of 2,000 miles. The media were the railroad and Western Union Telegraph wires and Edison's telephone. One office was at Bethlehem, Pa., and connection was made with the Eastern and Amboy wire, and at Perth, Amboy, with a Western Union wire, and thence to Chicago and North Bend, Nebraska, where the other office was located.

THE GALVANIC OXIDATION OF GOLD.—Grotthuss, says M. Berthelot, in *Comptes Rendus*, in his classic experiments on the decomposition of water by the galvanic pile (*Annales de Chimie*, t. lxviii., p. 60), remarked the solution of a gold wire employed as the positive pole in sulphuric acid traversed by the current. This interesting fact was pointed out to me by our venerated dean, M. Chevreul, who asked me if such an effect might not be due to the formation of persulphuric acid. It was for the purpose of replying to his question that I made the following experiments: I first repeated Grotthuss's experiment, which is precisely as he described it. The sulphuric acid (at 10 per cent.) becomes yellow, and rapidly dissolves the gold wire. The dissolved gold can easily be detected by means of stannous chloride. A portion is reprecipitated upon the negative pole.

Nitric acid, under the same conditions, equally attacks the gold, and becomes filled with a violaceous precipitate (gold or aurous oxide?), which remains in suspension.

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Dilute phosphoric acid, on the contrary, does not appreciably attack gold, even under the influence of the galvanic current; nor has potass any greater action. That gold is attacked by sulphuric and nitric acids is not due to ozone; for oxygen charged with ozone remains without action upon gold in the presence of water, whether pure or charged with sulphuric or nitric acid.

Nor does persulphuric acid (prepared by electrolysis) attack gold, even if it contains in addition a portion of oxygenated water.

It follows from these observations that the attacking of gold takes place solely from influence of the galvanic current, and at the contact of the electrode with the electrolysed liquid.

THE PHILOSOPHICAL MAGAZINE for December contains a very interesting and somewhat lengthy paper on "Magneto-Electric induction," by Frederick Guthrie and C. V. Boys, Assoc. Royal School of Mines.

GLASS-COVERED WIRE.—A patent was taken out in America, on June 20th of this year, for a system of coating wires or cables with vitreous material. It consists in inserting a lining of glass in a trough of sheet-iron or other metal, then laying the wires on the said lining, next inserting a top layer of glass, and finally consolidating the whole by heat or pressure, or both. Another patent, dated May 29, relates to drawing either the wires or vitreous mass away while the other remains stationary, also in passing the said wires finally through a suitably shaped die.

MR. BRUSH, in an article on the Brush machine in Van Nostrand's *Engineering Magazine*, makes, in conclusion, the following remarks: "Quite contradictory to the spirit of those portions of Mr. Schwendler's report, he (Mr. Schwendler) says in another place: 'If more than one light is produced in the same circuit by the same current, the external or available light becomes rapidly dearer with increase of the number of lights produced. For this reason already, if not for many others, the *division of light* must result in an engineering failure.' It seems scarcely possible that Mr. Schwendler could have overlooked the obvious fact that a current representing a given amount of energy, and adapted to produce the maximum light from one centre, may, by having its dimensions suitably altered, *i.e.*, its electro-motive force increased, and its volume diminished while its energy remains the same, be adapted to produce its maximum light from several small centres, instead of from one large one (provided, of course, the energy at each centre is not reduced below the "certain point" before defined). Yet he seems to have overlooked, or entirely ignored, this fact.

"The performance of the No. 7 Brush machine, with its 16 lamps, already detailed, proves unquestionably that the division of a large current energy among many lights in the same circuit, or, more properly, the *multiplication* of lights on a single circuit has resulted in a great engineering *success*. The votaries of the single-light system would advocate, in place of the single No. 7 Brush machine, the use of *sixteen* small machines, with their costly system of conductors. *Each* of these would require as much attendance, and involve as much expense for repairs, as the single large machine. At least 50 per cent., and probably about 100 per cent. more driving power would be required to produce sixteen lights of the same size, and the first cost of the apparatus would be vastly greater. Further, if the lights were required at any considerable distance from the source of power the single-light system must prove *entirely* impracticable."

ELECTRICITY AND PLANTS.—In a recent paper on the electric phenomena in Dionæa and other irritable plants, Professor Kunkel does not admit the existence of any electrical tension in the intact tissues of these plants, but he concludes that the currents developed upon spontaneous movements, and similarly upon artificial curvature, are due to movements of the liquid in the cells, caused by mere contact with the electrodes, or by either active or passive movements of the organs.

A NEW light company has started a subscription in Paris for £80,000. The system to be adopted is light by incandescence, the electricity being generated by an improved form of Bunsen battery.

MR. GLADSTONE'S SPEECH BY TELEPHONE.—On Saturday, November 29th, Mr. Gladstone addressed an audience in the Corn Exchange, Edinburgh; but as the enormous room was insufficient to hold the audience who flocked to hear the great orator, telephonic communication was established with the Oddfellows' Hall, a quarter of a mile distant. In describing the arrangement the *Daily News* correspondent says: "The audience distinctly heard the cheering and singing of the meeting in the Corn Exchange, and also heard the strains of the band. Lord Rosebery's voice was also recognised, and it was gathered that he was saying pleasant things about Mr. Gladstone. Next came a burst of cheering, the sound of which was suddenly stopped, and a long interval of silence followed, varied from time to time by the murmur of distant cheers. Then, as suddenly as silence had fallen, there came the sound of Mr. Gladstone's voice, and he was followed pretty well through 'some remarks on corn averages and the condition of India.' All this, which greatly mystified the telephonic audience, is capable of easy explanation. Observers of Mr. Gladstone's manners in the House of Commons will remember what an important part the right honourable gentleman's hat plays in his great speeches. He invariably places it on the table a little to one side of him, and on the top of it he places his notes, which he rapidly shuffles and rearranges as the oration progresses. This afternoon, bringing his hat to the table in his accustomed manner, he unconsciously planted it right in front of the cylinder of the telephone which had been fixed on the table, thus, of course, cutting off the means of communication. As the speech proceeded he began the rearrangement of the papers, and the movement of the hat, which latter he finally drew away from the telephone, and then became audible in another building a quarter of a mile off, 'some remarks on corn averages and the condition of India.'"

THE PASSIVITY OF IRON.—M. Louis Vareime, who has lately studied the phenomena of the passivity of iron when placed in nitric acid, as, for instance, in the Callan battery, concludes that the passivity is due to a film of nitric peroxide which collects on the surface of the iron, and thus protects it from further action. It is stated that this film can be observed by examination with the microscope.

CLARK'S STANDARD CELL.—The well-known zinc-mercury standard cell of Mr. Latimer Clark has been tested by M. Pellat, who finds that its electro-motive force is not so constant as is generally considered to be the case. M. Pellat's method of proving this result is to join up two similar cells in opposition and to observe if any difference of potential exists by means of an electrometer. It is stated that a difference equal to '01 of a Daniell cell has been found to exist between two cells apparently in all respects alike.

THE CAPE CABLE.—The Telegraph Construction and Maintenance Company's ships *Scotia* and *Kangaroo*

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commenced laying a further section of the Cape Cable on December 4th. The *Seine* with the Australian Duplicate Cable arrived at Aden on the 8th.

MANUFACTURE OF CAST-IRON MAGNETS.—M. Carré publishes some details of a process he has just patented for manufacturing magnets in cast iron. He melts soft metal, very slightly carburetted in crucibles, and runs it into moulds, adding from 10 to 15 per cent. of steel filings, according to the degree of carburation, to improve its quality. Good results are also obtained by adding to the iron, when melted in the crucible, from 1 to 1·5 per cent. of nickel and 25 to 30-thousandths of copper, or 2 per cent. of tin and 50-thousandths of copper. The addition of the copper and tin to the iron facilitates tempering it at a comparatively low (cherry-red) heat. The quantities of the added metals, especially of the tin, can be reduced without detriment to the quality of the result by tempering at a higher temperature as their proportion is decreased. The best result of all is obtained by tempering pure cast iron at as high a temperature as can possibly be attained, short of reaching a degree of heat which would misshape the moulded pieces, or expose them to the liability of fracture.

THE NICKEL PLATING COMPANY. — At their Birkampton Lane Works, Stockton-on-Tees, this firm has just taken some considerable contracts for nickel-plating the engine and ship fittings for Her Majesty's steamers. The company do very large quantities of this class of work by a special and patented process.—*Iron*.

THE LEEDS CHAMBER OF COMMERCE has appointed a committee to consider the charges made in England and America with regard to patents. It was stated that, whereas in England the cost of a patent amounted in the long run to nearly £200, the expense in America was only £12.

IT is rumoured that the Postal Telegraph authorities have laid "an information" against "The Edison Telephone Company" of London, for infringement of their Act of Parliament. It is also stated the infringement is by reason of the company having accepted collect messages.

DR. DE LA RUE has now in progress a battery of 11,000 cells similar in kind to that with which he experimented recently. It is expected that it cannot be finished before the spring of next year.

ON Friday, the 5th inst., the first part of the sale of the stock, plant, and instruments, &c., of the British Telegraph Manufactory (Limited), took place at the rooms of the auctioneer, Mr. J. C. Stevens, No. 38, King Street, Covent Garden. There was a good attendance of manufacturers, but the prices generally ruled low, in some cases remarkably so. Lot 42.—A forty-dial tablet, in mahogany case, sold for 11s. Lot 43.—A thirty-dial tablet, in mahogany case, 12s. Lot 69.—A seven-dial counter, in brass case, to count 10,000,000, and model wheel and magnet for same, on mahogany stand, was knocked down for 55s. Lot 88.—A magneto bell-pull, on mahogany show stand, and rotary clock-bell alarum, an exceedingly pretty little instrument, was sold for 14s. Lot 108.—A large size Wheatstone magneto-electric motor clock, for driving fifty or sixty sympathetic clocks, in mahogany case, ran up to the small sum of only 95s. No. 109, ditto, in teak case, 150s. Amongst the Gramme machines we may mention lot 136, small hand machine, with four magnets, £5 10s. Lot 137.—Ditto, £6 10s. Lot 138.—Ditto, with two compound horseshoe magnets, £7 10s. Lot 141.—Small steam Gramme light machine, without bobbin, £2. This, probably, a year or two ago would have been taken in stock at upwards of £90. Lot 144.—A large light machine, gives light equal to 6,000 candles, stated to require 4½ horse-power to drive it, fetched 46 guineas. This was the machine reported on by Professor Tyndall, and mentioned in *Engineering* about two years ago. In the telegraph department we may mention a Wheatstone A B C indicator and switch, 11s.; two coils for duplexing Wheatstone A B C instruments, 8s.; eleven single-needle instrument dials, with magnets and coil, complete, 50s. the lot. The second portion of the stock will be sold at the same place on Thursday, the 18th inst.

TRANSPARENCY OF METALS.—With the aid of electricity, films of several metals of such minute thickness as to allow light to pass through them can be produced. An electric current is passed into a wire of one of the metals that extends to a glass tube containing rarefied air or gases. The particles of metal that the electric current loosens from the wire are deposited on the sides of the tube and form a transparent film. The light that passes through gold was a very handsome green; silver produced blue; copper, light green; platina, bluish grey; zinc, dark bluish grey; and iron, brown. —*Chemiker Zeitung*.

MR. ANDERSON'S long promised work on "Lightning Conductors" will be issued in a few days. Messrs. Spon & Co., of Charing Cross, are the publishers. We believe this work will prove an able and exhaustive treatise on the subject.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of this society, held December 10th, Lt.-Col. BATEMAN-CHAMPAIN, R.E., (President), in the chair, the minutes of the last general meeting having been read and confirmed, the Annual Report of the Society was read by the Secretary.

The report stated that 7 foreign members, 8 members, 43 associates, and 1 student had been added to the society, making a total of 4 honorary members, 157 foreign members, 329 members, 506 associates, and 13 students, or a total of 1,019.

The recent losses experienced by the society through the deaths of Sir William Fothergill-Cooke, Professor Clerk-Maxwell, and Mr. R. S. Brough were alluded to, and regret expressed. The recent conference held in London was next referred to; its object was the revision of the regulations drawn up at the last conference held at St. Petersburg in 1875. The conference commenced June 10th and lasted to July 28th. The new regulations drawn up were to be in force on and after April 1st, 1880; the most noticeable feature being the charging of messages at per word. The entertainments given to the delegates were then mentioned, and it was explained that the collection of instruments exhibited at South Kensington on the occasion of the visit of the delegates to that place was intended to have been international, but in consequence of short notice it was impossible to arrange for foreign apparatus to be brought over and exhibited. The arrangement of the apparatus was under the management of Professor Hughes and Mr. A. Stroh. The contributions to the

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conference fund, as stated at the last meeting, were very satisfactory, and the disposal of the surplus for the binding of the Ronald's library was again alluded to. A list of the papers read before the society during the year was then given, and Col. Bolton's paper on "The Electric Light" was pointed out as being a particularly valuable contribution. The committee on "Wire Guages," it was stated, had agreed upon their report, and the latter would before long be issued; it was undertaken at the request of the Board of Trade. The committee on "Lightning Conductors," it was stated, would also shortly issue their report. The Ronald's library catalogue was well in hand, and 400 pages of it had already been set up in type, and of these 260, up to the letter M, were printed ready for use. It was stated that the subscriptions for the same were hardly as satisfactory as could be wished. The catalogue would contain references to 12,000 books and pamphlets. The binding of the books was being rapidly proceeded with, and 300 were already completed; the whole number would be ready next session. As one condition of the library being held by the society was that an application should be made for the incorporation of the society by Royal charter, it was satisfactory to know that active steps had been taken for this being done. The handsome gift of Dr. C. W. Siemens of £10,000 towards the erection of a suitable building for the several scientific societies which met in the building and elsewhere was mentioned. A committee to further the object had been appointed. The courtesy of the Institute of Civil Engineers in allowing the use of their lecture hall for the meetings of the society was pointed out. Some discussions having been raised with reference to the widening of the scope of the society, it was stated that the question had been taken into consideration, and an addition to the title of the society would probably be made. It was suggested that special evenings for purely electrical papers might be arranged for. In concluding the report it was stated that a large portion of the debts of the society had been wiped off, but that a large number of subscriptions were in arrear, otherwise the whole debt would be cancelled.

The adoption of the report was proposed by Col. CROSSMAN and seconded by Mr. R. GRAY and carried.

Sir CHARLES BRIGHT next proposed a vote of thanks to the Institution of Civil Engineers for their courtesy in allowing the meeting of the society to take place in their hall. This was seconded by Professor HUGHES, and carried unanimously.

A paper, by Mr. E. MARCH WEBB, on "Operations connected with the laying of the new Marseilles-Algiers cable," was then read by the author.

In June, 1871, the India Rubber, Gutta-Percha, and Telegraph Works Company laid a cable between Marseilles and Algiers for the French Government, under the superintendence of Mr. F. C. Webb, Sir Samuel Canning, Mr. Herbert Taylor, and M. Aithaud, engineer to the French Government. This cable weighs 1¼ ton per knot for the deep sea portion, and 4¼ tons per knot for the shore ends. The traffic over the line having greatly increased, the French Government found that another cable was necessary, and this was contracted for by the India Rubber Company, the specification stating that the conductor-resistance was not to exceed 12 ohms per knot, the inductive capacity not to exceed ·4 microfarads per knot, and the insulation resistance not to be less than 200 megohms per knot at 75° F. The weight of the conductor was specified at 106 lbs. per knot, and of the gutta-percha dielectric, which was to be laid on in three coatings, 139 lbs. per knot. The serving of the deep sea portion consists of 15 No. 13 galvanised iron wires; the weight of the manufactured cable was 1·50 tons, and the breaking strain 5¼ tons. The intermediate cables were served with ten No. 6 wires; the breaking strain of the whole being 6 tons, and the weight 3·16 tons. The shore end is served with 10 No. 0 wires; the weight of the complete cable being 10 tons, and the breaking strain 15 tons. The deep sea portion is covered with a serving of tarred tape. The galvanising of the iron wires was to stand a test of four dippings in a solution of sulphate of copper, consisting of one pound of sulphate of copper to five gallons of water.

The steamship *Dacia*, which laid the cable, was provided with engines of 170 horse-power, and was fitted with four main tanks for the cable, and five smaller ones for grapnel ropes, spare pieces of cable, &c. There are two decks, which was a very convenient arrangement, as jointing and splicing operations could be made always under cover. The dynamometer of the paying-out machinery was of the ordinary vertical type. The paying-out drum was fitted with engine power for hauling in when necessary, and was fitted with a powerful break. The picking-up gear was worked by a pair of 50 horse-power engines. The *Dacia* was, in the first instance, fitted up by Sir Charles Bright.

On the 15th September the shore end of the cable was landed at Algiers. This was done by having two large pulleys firmly anchored on the shore at some distance apart, a hawser being passed from the hauling machine on the ship round the two pulleys, and then attached to the cable. The ship being anchored, the hauling machinery was set running, and the end of the cable thus pulled on shore. A reference was made to a method adopted in landing a cable on the coast of Chili by means of locomotives, which in the case in question, ran on a railway close to the sea shore. The cable was lashed to a number of barrels,* which were cut loose when the end was on shore, and the cable commenced to be paid out; this enabled the whole length to be drawn straight and submerged without kinks. The use of barrels was preferable to boats, which were liable to be—and, in a case mentioned, were actually—upset in a heavy surf. The length of the shore end is 6·94 knots, and the intermediate cable 2·94 knots; the latter was submerged in 600 fathoms of water.

The electric light was used on board the ship with the greatest possible advantage and success; two Gramme machines were used, driven by 5 horse-power each. The Serrin and also the Silvertown hand regulator lamps were used. The Thomson sounding apparatus was next described, and several novel points and additions made in it explained.

The shore end at Algiers being laid, the ship steamed to Marseilles, taking 93 soundings on the way. These soundings were taken in the deepest water in from 20 to 30 minutes—10 to 11 soundings, each 10 to 11 miles distant, were taken every 24 hours. Specimens of the ooze in each case were brought up, and these were collected by Mr. Preece, who was on board the vessel. The deepest soundings were 1,500 fathoms. The French Government telegraph ship *Charente*, which assisted in the operations, was spoken of as being particularly well fitted with the necessary appliances.

On September 28th the shore end of the cable was landed at Marseilles. This was a work of great difficulty as the end of the cable had to be laid up a small stream to the cable hut, a distance of about a quarter of a mile, a low bridge having to be passed under on the way. Three boats were used for the purpose. At Marseilles 9·04 miles of shore end were laid, and 5·02 of intermediate cable.

On September 29th the laying of the deep sea portion was commenced towards Algiers. The "holding

* A full illustrated description of this method of landing cables was given in the number of the JOURNAL for May 15th, 1877.

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back" gear used in paying out, which was of very simple construction, was explained.

Mr. WEBB then mentioned that owing to representations by the Postal Telegraph Department of the Post Office, the Board of Trade had issued some important regulations with reference to signals to be carried by telegraph vessels. Three red lights in place of the ordinary white light being used by night, and three balls, 2 feet in diameter, hoisted at the foremast by day; those signals indicating that the ship was not under control. These regulations were to come into force on September 1st, 1880.

The clockwork testing arrangements in use in the testing hut during the paying out were next explained.

On October 2nd the buoyed end of the intermediate cable was reached, and in hauling the latter on board the chain holding it gave way, and the end was lost and had to be grappled for; in doing this, owing to the rocks on the bottom, great difficulty was experienced, and finally in completing the operation about one-third of the intermediate cable was lost. The old cable which was broken was grappled for by the *Charente*, and repaired October 11th. The old cable when raised to the surface was found to be in perfect condition, the galvanising of the protecting wires being quite bright.

In conclusion, Mr. WEBB expressed his obligation to the India Rubber Company, for the use of the various plans exhibited.

In the discussion which followed the reading of this most interesting and well-written paper—

COL. CROSSMAN said that, being on board the *Dacia* as a guest, he could testify to the admirable way in which the whole operations were conducted, and to the skill of the engineers carrying out the work. He spoke in high terms of the value of the electric light, and of the sounding apparatus employed.

Mr. F. C. WEBB drew attention to the ingenious automatic balancing weight attached to the sounding drum. In referring to the "holding back" gear, he pointed out that it replaced the old jockey-wheel apparatus previously employed, in which as many as seven wheels had been employed on board the *Great Eastern*. A clock testing arrangement, he stated, had been employed by him when laying the Hague cable. The arrangement being, that the clock put a current on the cable for a quarter of an hour, then insulated the cable for a quarter of an hour, and finally put it to earth for a quarter of an hour. A clock arrangement was also used in the laying of the old Red Sea cable, and on the Persian Gulf cable Messrs. Latimer Clark and Laws used a clock in connection with a condenser.

SIR CHARLES BRIGHT stated that the "holding back" gear used on board the *Dacia* was designed by him, and manufactured for the first time in 1871, at Jamaica. This gear was far preferable to the jockey-pulleys working in V wheels, as the compound on the cable was liable to stick in the latter. The *Dacia* was built at Sunderland, in 1869, and was afterwards lengthened under his direction. The tanks were built at Sunderland; the engines were built by Messrs. Easton and Anderson. The whole machinery, he stated, was the best yet designed. The clock testing apparatus was used by Henley, in 1860. In conclusion, SIR CHARLES congratulated Mr. R. Gray and Mr. Webb upon the work they had so ably carried out.

Mr. F. C. WEBB stated in reply to SIR CHARLES BRIGHT that the "holding back" gear was in reality designed by Mr. Matthew Gray.

Mr. PREECE said that in his opinion the landing of shore ends by barrels was not always the best method to be adopted, and that other methods were equally as good. He spoke strongly of the value of the electric light on the ship.

The importance of numerous soundings being taken on the proposed route of the cable he insisted very strongly upon. He had urged this necessity since 1860. In his opinion no cable had been yet laid which had had sufficient soundings taken for it. He then drew attention to the form of sounding weight employed, which had a butterfly valve at the base which enabled the ooze at the bottom of the sea to be brought to the surface. Samples of these would be brought before the Society if the examination of them proved that sufficient interest was attached to them.

In conclusion, Mr. PREECE proposed a vote of thanks to Mr. WEBB for his interesting paper, which was seconded by Mr. WILLOUGHBY SMITH.

The result of the ballot for the council for the ensuing year was then announced, the result being as follows:—

President—W. H. Preece, M.I.C.E. *Past Presidents*—Lieut.-Colonel J. U. Bateman-Champain, R.E.; Charles William Siemens, F.R.S., D.C.L.; Prof. Abel, C.B., F.R.S.; C. V. Walker, F.R.S.; Latimer Clark, C.E.; Sir William Thomson, F.R.S., LL.D.; Frank Ives Scudamore, C.B. *Vice Presidents*—Prof. G. C. Foster, F.R.S.; Carl Siemens, M.I.C.E.; Major C. E. Webber, R.E.; Willoughby Smith. *Hon. Treasurer*—Edward Graves. *Hon. Secretary*—Lieut.-Col. Frank Bolton. *Council* (Members remaining in office)—Prof. W. G. Adams, F.R.S.; W. A. Andrews; William T. Ansell; Sir Charles Bright; H. G. Erichsen; Colonel Glover, R.E.; Charles Hockin, M.A., C.E.; Louis Loeffler; C. E. Spagnoletti, M.I.C.E. *New Members*—Prof. D. E. Hughes; Augustus Stroh; C. F. Varley, F.R.S. *Associate Members of Council*—Alexander J. S. Adams; Captain Macgregor Greer, R.E.; J. T. Hill.

The meeting was then adjourned till Jan. 28th, 1880.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the second meeting of the Session, held on the 18th of November, Mr. W. H. BARLOW, F.R.S., Vice-President, in the chair, the paper read was on "Tunnel Outlets from Storage Reservoirs," by Mr. C. J. WOOD, M. Inst. C.E.

The subject was divided into the consideration of culverts in a direct line through an embankment, and tunnels round the end of the embankment as a distinct work. The author stated that the practice of laying pipes through an embankment, governed by valves at the foot of the outer slope, was reprehensible, and had been abandoned for a culvert of masonry or brickwork, in which the supply pipes were laid. This method was not satisfactory because of the settlement of the earthwork, and the subsidence of the puddle. In crossing the puddle trench, a stone or brickwork pillar had sometimes been used to remedy this difficulty with partial success, and in other cases, a "slip joint" had been made of the portion of the culvert crossing the trench, to allow a slight vertical movement. The advantages of a culvert through the embankment were speed, economy, and the building of the culvert in daylight; the author believed it best to drive a tunnel round or under the end of the embankment in the solid rock as a separate work, the tunnel to be lined with stone, brick, or cast-iron segments backed with concrete. The expense was in favour of the culvert directly through the embankment. The draw-off valves are now frequently at the bottom of a valve-pit built on the inside of the puddle trench in the embankment; they are sometimes placed at the foot of the inner slope; it had a sloping face, and was worked by rods up the inside slope. A culvert terminating in a

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valve-tower of masonry or iron was the best plan, the valves being in duplicate, one set inside, the other outside, the tower. The author advocated the tunnel clear of the embankment and valve-tower as the best and safest, if more costly, plan.

Some remarks followed on the works for the supply of water to Bradford, Yorkshire, which was obtained from three districts, viz., Oxenhope, Manywell Springs, and the Skipton district. The Stubden Reservoir had been abandoned in favour of a tunnel lined with cast-iron plates backed with concrete, terminating in a cast-iron valve-tower, erected from the design and under the superintendance of Mr. A. R. Binnie, M. Inst. C.E. This was to mend a leakage which had taken place.

The Leeming Compensation Reservoir for mill owners had been seriously fractured by the subsidence of the bank, which was mostly on a clay foundation, and it was considered unsafe to fill the reservoir. On the suggestion of Mr. Rawlinson, C.B., M. Inst. C.E., and of Mr. Binnie, on the latter taking charge of the Bradford Corporation Waterworks, the old culvert was abandoned, and a new tunnel was substituted, similar to the one at Stubden. The original culvert was afterwards filled on the inside with concrete.

In the case of the Leeshaw Reservoir, which was in course of construction, on Mr. Rawlnson's inspection, it was resolved to abandon the culvert already cracked, and to substitute a tunnel outlet and valve-tower of cast iron, similar to those at Leeming and Stubden; this had been successfully done, the reservoir filled, and the work had since proved most satisfactory. In two of the above cases the culverts were so damaged as to be a strong argument in favour of tunnel outlets distinct from the embankment.

The remainder of the paper explained the form and construction of the type of cast-iron tunnel outlet and valve-tower used in these works. These valve-towers had proved successful wherever erected. Mr. Binnie was the engineer for carrying out the works, the author being the resident engineer.

AT the fourth meeting of the Session held on the 2nd of December, Mr. BATEMAN, F.R.S., President, in the chair, the paper read was on "The Passenger Steamers of the Thames, the Mersey, and the Clyde," by Mr. W. CARSON, M. Inst. C.E.

It was stated that the bulk of the traffic by light-draught passenger steamers in Great Britain was carried on these rivers, and that each port had adopted a practice independent of the experience of the others. On the Thames above-bridge, small vessels of light draught, moderate speed, great steerage power, and well under engine control, were used, but at the expense of strength of build. On the Thames below-bridge, high speed and large carrying power led to the employment of long vessels. At Liverpool, the vessels were of heavier build, short length in proportion to beam, and great steerage power. On the Clyde the traffic somewhat resembled that of the lower Thames, but the river was more sluggish and there was less competition by land. Under these circumstances the vessels were superior in passenger accommodation, in power, and in the steering arrangements.

Some of the latest examples of the vessels employed in these three river-services were then described. The chief peculiarity of the ferry boats of the Mersey was that they had the bow and stern alike, with a rudder at each end.

It was next observed that river craft being engaged within smooth or partially smooth water limits, need not be so strongly built as sea-going vessels. The severest strains to river craft probably arose from their engine power, from the concentration of heavy machinery in the centres of the vessels, and from the weights of the fine ends which did not provide displacement to carry themselves. In considering their ultimate strength, it was pointed out that, from the long and stormy voyages which many river steamers had performed—work so far beyond that for which they had been designed—their perfect sea-worthiness for their proper duty was beyond question. From collision alone need danger be apprehended, and its results anticipated in their design. The precautions against this latter danger were stated to be: (1) effective division by bulkheads; (2) defence, especially for cross-river traffic, by overhanging sponsons; (3) perfect engine and steerage control. The steering ought to be performed by steam or water power in the larger vessels, with telegraphic communication in every case between the bridge and the engine-room. It was further suggested that an effective bulkhead division ought to be compulsory, and it would not be unreasonable to require that all seats should be fitted loose, and made buoyant, on vessels which carried so great an amount of human life in proportion to their tonnage as to render any adequate provision of boats impossible.

Review.

Electro-Plating. A Practical Handbook, including the Practice of Electrotyping. By J. W. URQUHART, C.E. London: Crosby, Lockwood & Co.

THE literature dealing with the subject of electro-plating and the processes allied to it is by no means so abundant but that there is ample room for the class of book written by Mr. Urquhart. Working directions on the art applicable to amateurs as well as professionals are much wanted, and the book in question goes a long way towards supplying this want. In a book of 200 pages, well printed and illustrated, Mr. Urquhart has certainly given a large amount of thoroughly practical information.

It is somewhat unfortunate that the author on the first page should have stated that "a current of electricity tends to decompose a metallic solution into *water* (the italic are ours) and a metal," as such a statement, coming so early in the work, tends to shake one's confidence in the author's knowledge of chemistry, a knowledge which we should think is highly necessary in dealing with the subject of electro-plating. On reading further on, however, this bad impression wears off, and we see that the author is at home in dealing with his subject.

The preparation of articles, the author points out, is a very essential point to be attended to, as dirty surfaces are the principal cause of failures.

In speaking of batteries, the Daniell, which we should think would be as good a form as any for electro-plating, is stated as giving too much trouble for rough work, though it is recommended for fine work, such as continuous gilding, that is, gilding wires drawn regularly through the solution. The Fuller's battery is spoken very highly of, but in a list giving the comparative electro-motive forces of batteries, it is put down as having an electro-motive force of 30, as compared with 100 for a Grove, and 30 for a Smee. As this table is for the use of workmen, it is decidedly misleading.

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In regulating the force of the current of electricity, the usual mode is to immerse the plates of the battery more or less in the liquid. It seems somewhat strange that a simple rheostat has not been used for the purpose.

Although the book contains several slips like those pointed out, yet it is undoubtedly a useful work, and one which can be recommended.

New Patents—1879.

4708. "Improvements in, and connected with, electric bells; specially designed for signalling from the rooms of passenger ships and hotels, and for other like purposes." J. WHITE. Dated November 19.

4718. "Apparatus for holding the electrodes for use in electric lighting." W. B. GODFREY. Dated Nov. 20.

4785. "An improved electric motor." T. J. SMITH. (Communicated by H. Chameroy.) Dated November 24.

4796. "Electric lighting apparatus." T. E. GATEHOUSE. Dated November 25.

4903. "Improvements in apparatus, and in the arrangement of mechanism and parts to facilitate conversation by telephone between persons at distant places." C. E. SCRIBNER. (Partly communicated by G. D. Clark, M. G. Kellogg, and G. B. Scott.) Dated November 29.

4916. "New or improved compositions for insulating telegraph wires, cables, or other conductors of electricity." J. C. MEWBURN. (Communicated by J. Heins.) Dated December 1.

4948. "Electric signals for railways." J. J. CONKLIN. Dated December 3.

4967. "Pneumatic and electric signalling or communicating apparatus." J. and S. CLARK. Dated December 4.

4976. "Improved means and apparatus for effecting telephonic communication." J. IMRAY. (Communicated by R. G. Brown and J. F. Bailey.) Complete.

5004. "Telephones." J. IMRAY. (Communicated by J. F. Bailey.) Dated December 6. Complete.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

1531. "Apparatus for telephonic and microphonic purposes." JAMES WILLIAM THOMAS CADETT. Dated April 18. 6d. Consists of a series of microphones on boards or diaphragms, with connecting or coupling arrangements, permitting of arrangements being made to suit the electric power employed, and also the resistance of the line wire, telephone, or other receiver or receivers, and so forth.

1622. "Improvements in the means employed for producing electric light." RICHARD COMINGS THOMPSON. Dated April 24 2d. Relates to the electrodes used in the production of the electric light, and consists in the employment either in a dry powdered, or in a moistened and plastic state, of the carbon or carbonaceous material or composition usually made into solid pencils or sticks of carbon for the purpose. One advantage being that the supply of the carbon may thus be made practically continuous. (*Not proceeded with.*)

2652. "Improvements in electric lamps." CHARLES WILLIAM SIEMENS. (A communication from abroad, by Friederich von Refner Alteneck of Berlin.) Dated July 1. 6d. Relates to a method of regulating electric lamps by the counteracting forces of two coils of different resistance, through one or other of which the lamp current was shunted. For this purpose the electric conductor in some part of its course to or from, or in the lamp, divides into two branches, the one leading through the coil of a solenoid or electro-magnet of high resistance, directly back to the external circuit, and the other leading through the coil of a solenoid or electro-magnet of lower resistance indirectly back to the external circuit through the carbons and the lamp. The cores of the two solenoids or the armatures of the two electro-magnets are connected by a lever to one of the carbon holders in such a manner that, when the one solenoid or electro-magnet, namely, that having the coil of high resistance, is excited, the movement of its core or armature causes the carbons to approach towards each other, and when the other solenoid or electro-magnet, namely, that having the coil of low resistance, is excited, the carbons are caused to recede from one another, and thus, when both are excited, the carbons are caused to take a position dependent on the relation of the two counteracting forces operating upon them, which position, by suitable adjustments, can be determined so as to produce the desired illuminating voltaic arc. (A full description of this lamp is published on page 412 of the present number o this JOURNAL.)

3410. "Improvements in electric batteries." WM. MORGAN BROWN. (A communication from abroad, by Colonel William Fitz-Charles McCarthy.) Dated August 25. 6d. Complete. This refers to the compositions for and methods of arranging electric batteries, as well as to the mode of using such batteries for electric purposes in general, and more particularly for the production of electric light. The principle of the invention is based upon the peculiar qualities of the currents produced by different elements. It is well known that certain elements act with pushing power, that is to say, they force or push the current away from one of their poles on the conducting wire, whilst other elements have a strong tendency to attract the current from its conducting wire towards one of their poles. The object of this invention is to utilise these peculiar qualities, and the combination in one single battery of two classes of elements which exhibit in a high degree these different qualities forms an important part in this new system.

General Science.

SCANDIUM, A NEW EARTHY METAL.—L. V. Wilson announces the discovery of a new metal, to which he has given the name of Scandium. It has been separated from ytterbia, but has not yet been obtained in a state of purity. It is the oxide of a white earth, which gives no absorption bands. After ignition, it is attacked but slowly by dilute nitric acid, but more readily by hydrochloric acid. The solution of the nitrate is completely precipitated by oxalic acid.

NORWEGIUM.—This name has been given by Dr. Tellef Dahll to a newly-discovered metal, occurring in the copper-nickel and nickel-glance of Oteroeë, a small island near the town of Krageroë, Skjœrgarden, in Norway. The mineral is roasted, the product dissolved

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in acid, and precipitated by sulphuretted hydrogen, and the well-washed precipitate, free from nickel, again roasted. The product then obtained is the crude oxide of Norwegium. It is next to be dissolved in aqua regia, and precipitated with the right amount of potash (in excess of the re-agent the oxide re-dissolves), whereby an emerald-green precipitate of norwegium hydrate is obtained. This has now to be reduced with carbon or hydrogen. The metal is white, pretty malleable, of the hardness of copper, melts at a low red heat, has a density of 9·44, is soluble with difficulty in hydrochloric acid, but readily so in nitric acid; the solution is blue, and when diluted, becomes green; the metal is also soluble in dilute sulphuric acid.

A PRACTICAL CALCULATING MACHINE.—The *arithmometer* or calculating machine of M. Thomas, of Colmar, was invented in 1820. Since then it has undergone many improvements at the hands of the inventor, and latterly of his son, M. Thomas de Bojano, so that it is now offered in a form which M. Sebert, in a recent report to the Paris Société d'Encouragement, pronounces to be thoroughly adapted for practical use. The machine performs all ordinary arithmetical operations, comprising the extraction of roots. Among the more important recent improvements (for details of which we must refer to the *Bulletin* of the Society just named) is the counter of the number of turns of the motor handle, and the automatic inscription of successive figures of results, in divisions and extractions of roots, and of multipliers in multiplications, relieving the mind of the operator greatly. An idea of the progress of the machine may be had from the fact that the product of the number 99,999,999 by itself, is formed by the new machine in 24 seconds; it took nearly a minute in 1851. The new machine can also go beyond the former in giving the product of the number formed of ten nines by itself, which it does in 28 seconds. The product of the number formed of eight nines by the number formed of eight fives is now obtained in 17 seconds as against about 45 seconds in 1851. Processes of addition alone are not performed much more quickly than by an expert calculator, but mental fatigue is at least saved. The machine is well adapted for complex operations, as in calculations of algebraic formulæ, or ordinary calculations relative to constructions, cubages, estimates, &c., for calculation of formulæ into which trigonometrical values enter, and here it allows of dispensing with the use of logarithms, tables of natural trigonometrical lines being used. In construction of tables of multiplication, ready reckoners, &c., the machine gives results that are truly marvellous. The popularisation of the machine has been slow, but (with removal of imperfections) has considerably improved, as the following figures show:—In the 44 years, from 1821 to 1865, only 500 machines were sold; in the 13 years, from 1865 to 1878, 1000—viz., 300 in the five years, 1865 to 1870, 400 from 1870 to 1875, and 300 from 1875 to 1878, or 100 a year. Of the latter number about three-tenths are six figure machines, six-tenths eight figure, and only one-tenth ten figure. Of 100 machines sold, 60 go abroad, and only 40 remain in France. Among other establishments in France which use the machine may be mentioned the Magasins du Louvre, the Compagnie des Petites Voitures, the Offices of the Artillery Service, Assurance and Railway Companies, the Observatory, the Ecole Polytechnique, and Creusot. It is estimated that a machine will work daily for ten years before requiring repair; and, from the nature of the component parts, repair is easy. The price is rather high, 500f. for a six-figure machine; and M. Sebert is of opinion, considering how largely the manufacture involves the easy repetition of similar pieces, that this might be organised as to supply the machines at half the present price.

SILVERING MIRRORS.—An improvement in silvering mirrors, by which excellent results are obtained, and which at the same time spares the workmen the danger of exposure to the effect of mercurial vapours, has just been accorded a prize of 2,500 francs by the French Academy. The inventor is M. Lenoir, and his procedure is substantially as follows: the glass is first silvered by means of tartaric acid and ammoniacal nitrate silver, and then exposed to the action of a weak solution of double cyanide of mercury and potassium. When the mercurial solution has spread uniformly over the surface, fine zinc dust is powdered over it, which promptly reduces the quicksilver, and permits it to form a white and brilliant silver amalgam, adhering strongly to the glass, and which is affirmed to be free from the yellowish tint of ordinary silvered glass, and not easily affected by sulphurous emanations.

THE SOLUBILITY OF SOLIDS IN GASES.—Messrs. J. B. Hannay and J. Hogarth, in a paper brought before the Royal Society, have investigated the solubility of solids in gases. The object of the investigation was to determine under what particular conditions liquids are dynamically comparable, in order that the micros-heometrical method devised by the authors might be applied to determine their molecular mass and energy relations. At a certain point, called the "critical" point, the laws relating to solids and gases become merged. To investigate the conditions beyond the critical point the authors dissolved in a liquid some solid whose fusing point was much above the critical point of the liquid, and noticed whether, on the latter passing the critical point and assuming the gaseous condition, the solid was precipitated or remained in solution. The result showed that the solid was not deposited even when the temperature was raised 130° above the critical point. Some solutions show curious reactions at the critical point. Thus ethyl, alcohol, or ether deposits fine chloride from solution just below the critical point, but redissolves it in the gas when it has been raised 8° or 10° above that temperature.

LARGE GAS-HOLDERS.—The Birmingham Corporation Gas Works, Saltley, have just had two of their gas-holders increased in capacity by "telescoping." The execution of the work has been one of great difficulty, as the existing sides of the gas-holders had to be cut clear away from the top framing, and in each case the weight of the latter, about 250 tons, has had to be supported on framing 42 ft. from the bottom of the tank in which the gas-holder works. The sides so cut away have been converted into the outer vessels, and new sides had to be constructed in the tank to form the inner vessel, to which the top had again to be connected. The capacity of each of the holders by this means has been increased from 1,100,000 to 2,200,000 cubic feet. The contractors for the work (Messrs. Ashmore and White, of Stockton-on-Tees) are about to construct an enormous holder for the South Metropolitan Gas Company to contain no less than 5,000,000 cubic feet of gas.

NAVIGATION ON THE MISSISSIPPI.—The recent improvements effected at the mouth of this river have been such that a short time ago the Inman s.s. *City of Bristol*, drawing 24 feet 7 inches of water, passed through the jetties without obstruction either at the jetties or at the head of the pass.

THE TUNNEL UNDER THE MERSEY.—On Monday, December 8th, a commencement was made of the

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tunnel to be driven under the Mersey. The engineers propose to drive trial headings from both the Liverpool and Cheshire sides of the river, and when the nature of the strata is ascertained, to commence the main railway tunnel.

URALIUM, A NEW METAL.—As far back as 1869 the author discovered this metal in commercial platinum obtained from Russian ores. Next to silver it is the whitest metal known; its malleability is as great as that of the purest platinum, but its ductility is much greater, and it is almost as soft as lead. Its melting point lies near to that of platinum, and it is not volatile. Its specific gravity = 20·25, and its molecular volume, like those of osmium, platinum, and palladium, is 6·25. Its atomic weight has been found 187·25. In its chemical properties it is difficult to distinguish from platinum.—*A. Guyard.*

HEAT REGULATOR.—We were shown a few days ago, by Mr. Tisley, of the Brompton Road, a very neat form of heat regulator, designed by Mr. Williams, who is, we believe, assistant to Dr. Thudicum. It is an improvement on that invented by Mr. Page, of the London

University, and used by Professor Tyndall in his experiments on germs. It consists of a glass tube and bulb containing mercury. The tube has two branches (A and B) at the top, each connected with the gas-pipe supplying a Bunsen burner. There is also a third branch (C), up which the mercury also rises, and in which is inserted a regulating plug of wire (P). This having been adjusted to any necessary degree of sensitiveness, the bulb being placed in position, the rising of the mercury in the tube A will, by shutting off the gas supply, restrain the temperature from rising above the desired pitch.

REGISTERED STOCK.
IMPORTANT DECISION.

TO THE EDITOR OF "THE DAILY TELEGRAPH."

"Sir—The decison in the case of 'Simm and Ingelow *versus* the Anglo-American Telegraph Company,' decided in the Court of Appeal yesterday, is so important to holders of registered stocks and shares, and so subversive of the general belief hitherto entertained, that we would draw attention to the facts, which, briefly stated are as follows:—We purchased in 1876, *bonâ fide* in open market, £5,000 Anglo-American stock, paid the money for it, and it was duly registered in our nominees' names. They received the company's certificate of registration, and subsequently three dividends upon the stock.

"Ultimately the signature of the original transferror was found to have been forged, and the Telegraph Company claimed the stock back again. The Court of Appeal, reversing the decision of Mr. Justice Lindley, uphold this claim of the company.

"Henceforward any *bonâ fide* investor in registered stock may find that a security, which upon the faith of an official certificate of ownership he has regarded as indisputable, may prove worse than waste paper.—Yours obediently, "BURGE, BROWN, and DENNIS.

"3, Austinfriars, E.C., Dec. 6."

THE liquidators of the Direct United States Cable Company (Limited, in liquidation, give notice that a first and final dividend of 3s. 8d. per share will be payable at the offices of Messrs. Deloitte, Dever, and Co., on and after Dec. 29th inst., to those members who were on the register on Aug. 8th, 1877, and who accepted shares in the Direct United States Cable Company (Limited), incorporated in 1877, in lieu of the shares held by them in the other company.

THE directors of the Brazilian Submarine Telegraph Company (Limited have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, for the quarter ended Sept 30 last.

The following are the final quotations of telegraphs for Dec. 12th:—Anglo-American, Limited, 55⅜-56¼; Ditto, Preferred, 81⅛-82; Ditto, Deferred, 31¼-31¾; Brazilian Submarine, Limited 7⅛-7⅜; Cuba, Limited, 8¼-8⅜; Cuba, Limited, 10 per cent Preference, 15⅛-16⅛; Direct Spanish, Limited, 2¼-2⅜; Direct Spanish, 10 per cent. Preference, 12-12½; Direct United States Cable, Limited, 1877, 10⅛-10⅜; Eastern, Limited, 8⅛-8⅜; Eastern, 6 per cent. Debentures repayable Oct., 1883, 102-105; Eastern 5 per cent. Debentures repayable Aug., 1878, 101-104; Eastern, 6 per cent. Preference, 11¼-12; Eastern Extension, Australasian and China, Limited, 8⅛-8⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 101-102; Ditto, registered, repayable 1900, 101½-102½; German Union Telegraph and Trust, 8¼-8¾; Globe Telegraph and Trust, Limited 4⅞-5⅛; Globe, 6 per cent. Preference, 11-11¼; Great Northern, 8¾-9; Indo-European, Limited, 22¼-23¼; Mediterranean Extension, Limited, 2⅜-3¼; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Reuter's Limited, 10-11; Submarine, 230-240; Submarine Scrip, 2⅛-2⅜; West Coast of America, Limited, 1-1¼; West India and Panama, Limited, 1⅛-1⅞; Ditto, 6 per cent. First Preference, 7¼-7⅝; Ditto, ditto, Second Preference, 6½-7; Western and Brazilian, Limited, 5⅛-5⅞; Ditto, 6 per cent. Debentures "A," 97-100, Ditto, ditto, ditto, "B," 96-100; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 34-36; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2⅜-3; India Rubber Co., 12⅜-13¼; Ditto, 6 per cent. Debenture, 105-107.

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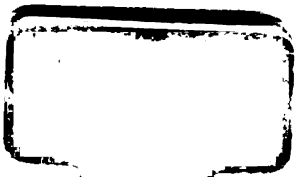

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